Heathkit

µMATIC ™
MEMORY KEYER

Model SA-5010A

INTRODUCTION

The SA-5010A µMatic Memory Keyer is a compact unit with modern design in electronics and styling. The Memory Keyer uses a microprocessor which keeps component count low and reliability high. Features of the Memory Keyer include:

1. Up to 10 buffers for storing text or commands. These are variable length buffers, which eliminates wasted memory space. Available memory is also effectively increased by the use of "command strings" and by a repeat feature which allows you to automatically send a message up to ten times.

2. An editing feature which allows easy recovery from errors when you load a message buffer.

3. A built-in sidetone oscillator and speaker with variable volume and pitch. A phone jack and earphone are provided for private use.

4. A thin 22-position keypad lets you select character formation, speed character spacing, character weighting, message repeat count, buffer number and mode. The sidetone is gated to provide audible feedback to produce a "click". Illegal entries and error conditions produce a "warble".

5. Integral capacitive "touch" paddles which reduce fatigue. The paddles unplug and store inside the keyer when not in use. Also, a rear panel jack is provided for an external mechanical paddle assembly.

6. Full "iambic" features.

7. Five LEDs to indicate the current mode of the keyer.

8. A "practice" mode which allows you to send random code groups of random length and selectable types (alpha, alphanumeric and alphanumeric plus punctuation). 100 different repeatable random sequences are available, all of which are altered every time you turn on the keyer.

9. A P/C key which allows you to pause, manually insert text into a buffer message being sent and then continue. When you insert a pause character in a message or command string, an automatic pause is made at that point, so you can manually insert text.

10. CMOS memory with battery backup to retain the buffer contents, as well as the last-selected speed, spacing, weight and repeat count while the keyer is turned off and unplugged.

11. Selection of either right-handed or left-handed operation from the keypad.

12. Built-in diagnostics that check the microprocessor each time the keyer is turned on and test RAM when batteries are replaced or when the keyer is reset.

13. Automatic shutoff after more than approximately 15 minutes of non-use.

ASSEMBLY NOTES

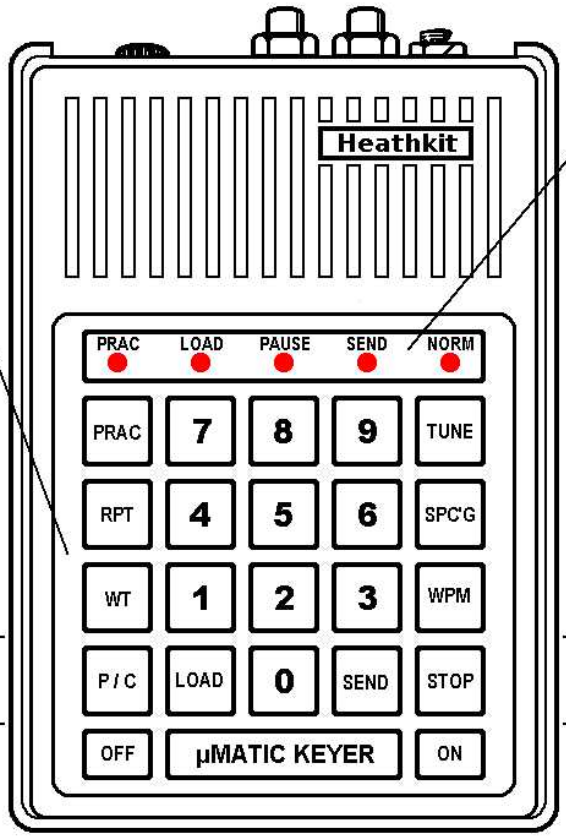
Diese Abschrift des originalen Manuals von 1985 wurde im April 2018 gefertigt. Es wird daher davon ausgegangen, dass jetzt ein fertig aufgebautes Gerät vorliegt. Auf die Wiedergabe der Aufbauhinweise wird daher verzichtet.

This copy of the original manual printed 1985 was made in April 2018. It is therefore assumed that there is now a ready-built device. The reproduction of the construction instructions is therefore omitted.

73, Bernd, DC7XJ

KEYPAD: Controls the function, mode and operation of the keyer.

STATUS LEDs: Allow a visual indication of the keyer's mode of operation.



*VOLUME control: Controls the loudness of the sidetone.

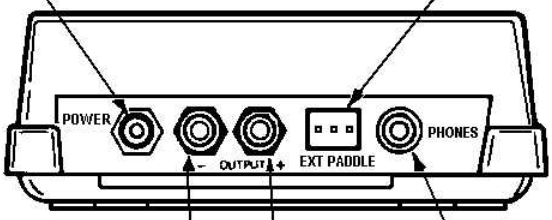
*PITCH control: Varies the frequency of the sidetone.

* PADDLES control: Adjust paddles sensitivity.

*Access holes are located in case bottom

POWER jack: Powers keyer from either the 8.5 VAC transformer or from an external power supply.

EXT PADDLE plug: Allows use of external mechanical paddle assembly.



OUTPUT (– & +) jacks: For use with negative (–) or positive (+) keylines.

PHONES jack: Allows the use of an earphone for private sending or practice.

OPERATION

TRANSMITTER TUNE-UP

When you press the TUNE key with the keyer in the NORMal mode, or when you are paused in the SEND or PRACtice mode, the transmitter will be keyed continuously. (Note that, if the keyer is in PAUSE but the current character has not "completed", the TUNE key is not active until it completes). The TUNE function is stopped when you press any key other than TUNE, in which case that key will also perform its normal function for the current mode, or when you touch either paddle.

SETTING SPEED

When you press one or two digit keys and follow with the WPM key, the speed will be set to that value. The "spacing" is automatically set to the same value. If you desire to space the characters further apart to achieve a slower net speed, then you must set the spacing after the speed, as is described in the following paragraph.

SETTING SPACING

It is sometimes desirable to have characters formed at one speed and sent at a slower speed. When you are learning code or learning to recognize single characters at a high speed, you may want to insert longer than normal spaces between characters an between words, to allow you more time to think. You can accomplish this by first selecting the formation speed as described under "Seeting Speed", and then selecting the spacing by pressing one or two digit keys, followed by the SPC'G key.

NOTES:

1. If you attempt to select a spacing speed that is greater than the currently set formation speed, the sidetone will "warble" to indicate the error, and no change will occur.

2. The correspondence between the number you use to set the spacing and the actual net sending speed is not a one-to-one relationship (ratio). The ratios are shown in the graph of Pictorial 6-2 (Illustration Booklet, Page 8).

3. When you press SPC'G with no preceding digit key, the spacing returns to the same value you selected with the [WPM] key.

SETTING CHARACTER WEIGHT

The normal ratio of dot/dash/element space is 1:3:1. You can alter this ratio by using the WT key. When you press a single digit key **n**, followed by the WT key, it sets the timing as follows:

1. If you press WT with no preceding digit, the normal timing ratio shown above is used. This means that the length of a dash is three times as long as that of a dot.

2. If *n* (your specified digit) is between 0 and 4, inclusive, the interelement space is increased in length, and the dot and dash lengths are correspondingly decreased. This results in a "lighter" weighting with digit "0" being the lightest. With "0", the length of a dash is 4.4 times that of a dot.

3. When you select a digit between 5 and 9, inclusive, the interelement space is decreased in length and the dot and the dash length are correspondingly increased. This results in a "heavier" weighting with digit 9 being the heaviest. With 9, the length of a dash is 2.4 times that of a dot.

CODE PRACTICE

Automatic code practice is available by pressing keys **n** and PRAC. **n** is a single-digit or double-digit number and establishes a "seed" for a random character generator. The single digit (or second digit of a double digit entry) also selects the character types to be generated for practice as follows:

n = 1 – 3:	Sends alpha characters (A through Z)
n = 4 – 6:	Sends alphanumeric characters (A – Z and 0 – 9)
n = 7 – 9:	Sends alphanumeric characters plus . , ? / – – –
n = 0:	Sends alphanumeric characters plus . , ? / – – – : ; ' " (!

NOTE: Refer to "Random Code Practice" on Page 13 for sample sequences.

You can end the practice mode with the STOP key, and pause with the P/C key. As an example:

When you press the **3** **5** PRAC keys, random alphanumeric code groups of random lengths are sent out, using "35" as a seed. If you use this same speed later, the sequence will repeat (provided the keyer has not been turned off in the meantime), so you can check your copy.

NOTE: Each time you turn the keyer on, all 100 of the possible "seeds", from 0 to 99, produce different sequences than they did the last time the keyer was on. This "randomization" repeats only after turning the keyer off and on 64 times (if not RESET). There are therefore 6,400 different, yet repeatable practice sessions available and each sequence repeats after sending approximately 3000 characters. (Each character is sent either 64 or 128 times. Twice as many vowels as other characters are sent in Alphanumeric-plus-common-punctuation mode; vowels and easier characters are likewise favored in the Alphanumeric mode.)

LOADING A MESSAGE BUFFER

Buffers 0 through 9 are available for storage of text sent from the paddles, or of command strings, which will be described later. All buffer space holds a maximum of 240 characters and wordspaces (or keystrokes, in the case of a command buffer). When room for 20 or less characters remains in memory, the pitch of the sidetone drops noticeably as a warning. If you use up the buffer space, the sidetone will warble, and the keyer will return to the NORMal mode. (The last character will be stored.) To store text in a buffer, use the following sequence:

1. Select a comfortable speed as described above.

2. Press the **n** key to select the desire buffer. (If you select the wrong digit key by mistake, simply follow it with the intended key.)

3. Press the LOAD key. This clears the buffer and disables the keyer output. At this point, you should press no other key on the keypad or the keyer will enter the "load command" mode, and the paddles will become inactive.

4. Begin sending. The keyer will tolerate somewhat inaccurate sending. A paddle closure intended as part of the character currently being formed, may occur up to one interelement space time later than would be correct for perfectly formed code. When you reach the end of a word, a pause of just over 1½ normal wordspaces is required to cause a wordspace "character" to be stored in the buffer. This makes the intercharacter spacing much less critical, and you will find it much easier to load text than with other keyers, as long as you follow this one rule.

The delay between words may be as long as you desire; only one wordspace will occur at that point. You may store one or more automatic pauses into a buffer by pressing the P/C key at the points you desire. When you send a message, it automatically pauses and allows you to insert text using the paddles. By pressing the P/C key, the message will continue from where it left off.

Characters longer than six dots plus dashes will be ignored and must be re-sent. The only important exception to this is that, when seven or more dots are sent, it is treated as an ERROR. The result will be the deletion of the previous character from the buffer (or wordspace, if enough time has elapsed for the keyer to insert one), which may immediately be re-sent correctly in order to recover the mis-sent character. One character or wordspace is deleted for each ERROR character.

5. After you enter the last character, press the STOP key to terminate the message and return to the NORMal mode. (if you wait 1½+ wordspace times before you press STOP, a wordspace will be inserted as the last "character" in the message buffer.)

NOTES:

1. A character of exactly six dots will cause an extra space to occur at that point in the text which is equal four interelement spaces.

2. A wordspace is normally not stored as the first "character in a buffer. If you desire to load a wordspace as the first character, activate the dash paddle long enough to form a string of least seven dashes. Then wait 1½+ wordspace times before you load the first desired Morse character.

SETTING THE MESSAGE REPEAT COUNT

You can cause the message buffer to automatically repeat up to nine times (sent up to 10 times) by first setting the desired repeat count. (Sending a message buffer is explained in the following paragraph.) When you press the **n** RPT keys, this sets the repeat count to **n**. Any message buffer you send will then automatically repeat **n** times. The repeat count will remain set to this value until you set it to another number, or reset it to zero by pressing **0** RPT, or simply RPT.

SENDING A MESSAGE BUFFER

A message buffer is sent when you press **n** SEND, where **n** is the number of the desired message. (If you do not specify **n**, buffer 0 is assumed.) You can stop the message by using one of the following conditions:

1. The message completes itself after being sent the specified number of times. The keyer will then return to the NORMal mode.

2. The message encounters a PAUSE in the message text. You may now insert text by using the paddles as described earlier. Pressing the P/C key will cause the message of continue from where it left off.

3. When you press the P/C key, the keyer will complete the current character without a pause. (The results are the same as in the previous step.)

4. If you press the STOP key, the message will abort immediately.

NOTE: When you listen to the keyer sidetone, the first character sent after pressing SEND may appear to begin with an extra dot. This is only the keypad "click", which does not key the output jacks.

LOADING A COMMAND BUFFER

You can use any of the ten buffers to designate a sequence of messages to be sent and, in addition, alter the speed, spacing, weight and repeat count. This feature makes the Memory Keyer especially versatile. For example, assume buffers 0 through 4 hold the following data:

#0: **2** **0** WPM **2** RPT **1** SEND RPT **2** SEND **2** RPT **4** SPC'G **3** SEND RPT
3 **0** WPM **4** SEND

#1: <CALL>
#2: DE
#3: DC7XJ
#4: IN BERLIN <. . . . . .> <. . . . . .> K

When you load the call of a station into buffer #1 and press the SEND key, the call will be sent three times, followed by "DE", then "DC7XJ" sent three times, (all at 20 WPM), followed by the contents of buffer #4, sent once at 30 WPM, with an extended space before the "K". The keyer will then return to the NORMal mode with all the parameters set as they were originally. This is only one example of what can be accomplished.

When you want to load a command string into a buffer, use the same procedure as when you load a message, except that if you press a keypad button after you press **n** LOAD, the paddles become inactive and he keyer is in the "load command" mode. After you make the last entry, press STOP to return to the NORMal mode. As when you load text, the pitch of the keypad click will drop when room for 20 characters remains; the sidetone will warble and the keyer will return to the NORMal mode if the last key you press has filled the buffer space.

Here is another example of how you can use a command buffer:

Assume that buffers #0, #1 and #2 are loaded as follows:

#0: DE K8TP UR RST P/C BERRIEN BERRIEN BK P/C
BK QSL TU <. . . . . .> <. . . . . .> QRZ K8TP K P/C

#1: CQ SS CQ SS CQ SS DE MICH DE K8TP K8TP K

#2: **9** RPT SEND SEND SEND SEND . . . SEND

Now, if you desire to participate in a contest, you can establish a contact by pressing **1** SEND. Once you establish communication, you can transmit a report to the other station by pressing **2** SEND, and pause for their report. Once you have received their report, you can acknowledge and request another station to reply by pressing P/C. The keyer will automatically pause for manual insertion of "RST" report. (NOTE: Use of the special space character <. . . . . .>, extends the wordspace before the QRZ.) From this point on, as long as the stations reply to the QRZ, the only key that you will have to press is P/C. For each time you loaded the SEND key into buffer #2, buffer #0 will be sent ten times (due to the **9** RPT).

NOTES:

1. Any parameters that you change within a command string will return to the values you last set from the keypad when the keyer returns to the NORMal mode.

2. You should avoid using extra digit keys in a command buffer since they waste buffer space.

SELF DIAGNOSTICS

Each time you turn the keyer on, a checksum is performed on the contents of the program in ROM. If this test fails, a steady sidetone will sound and all of the LEDs will light.

When you turn the keyer on for the first time following a battery replacement, a test is run by the keyer on RAM. If this test is successful, the speed and spacing are both initialized to 20 WPM, the weight is set to normal, the repeat count set to zero and all the buffers are cleared. If a bad cell is found, the sidetone will sound a steady tone and no LEDs will light.

RESETTING THE KEYER

When you press the P/C and STOP keys simultaneously*, the the diagnostics for RAM and ROM are performed. All the buffers are cleared and the keyer is initialized as in the previous paragraph.

REVERSE PADDLES

When you press the LOAD and SEND keys simultaneously*, the keyer circuitry toggles between right-handed and left-handed operation. The keyer always powers up in the right handed mode unless you have the left-handed wiring option.

*NOTE: If you press one key slightly ahead of the other, the first key you press will be recognized as a single closure and will begin to perform its normal function, or cause the sidetone to warble if it is not a legal key for the current mode. The two keys must be held down long enough so they can be recognized as a pair. When you release the keys, the keyer will return to the NORMal mode.

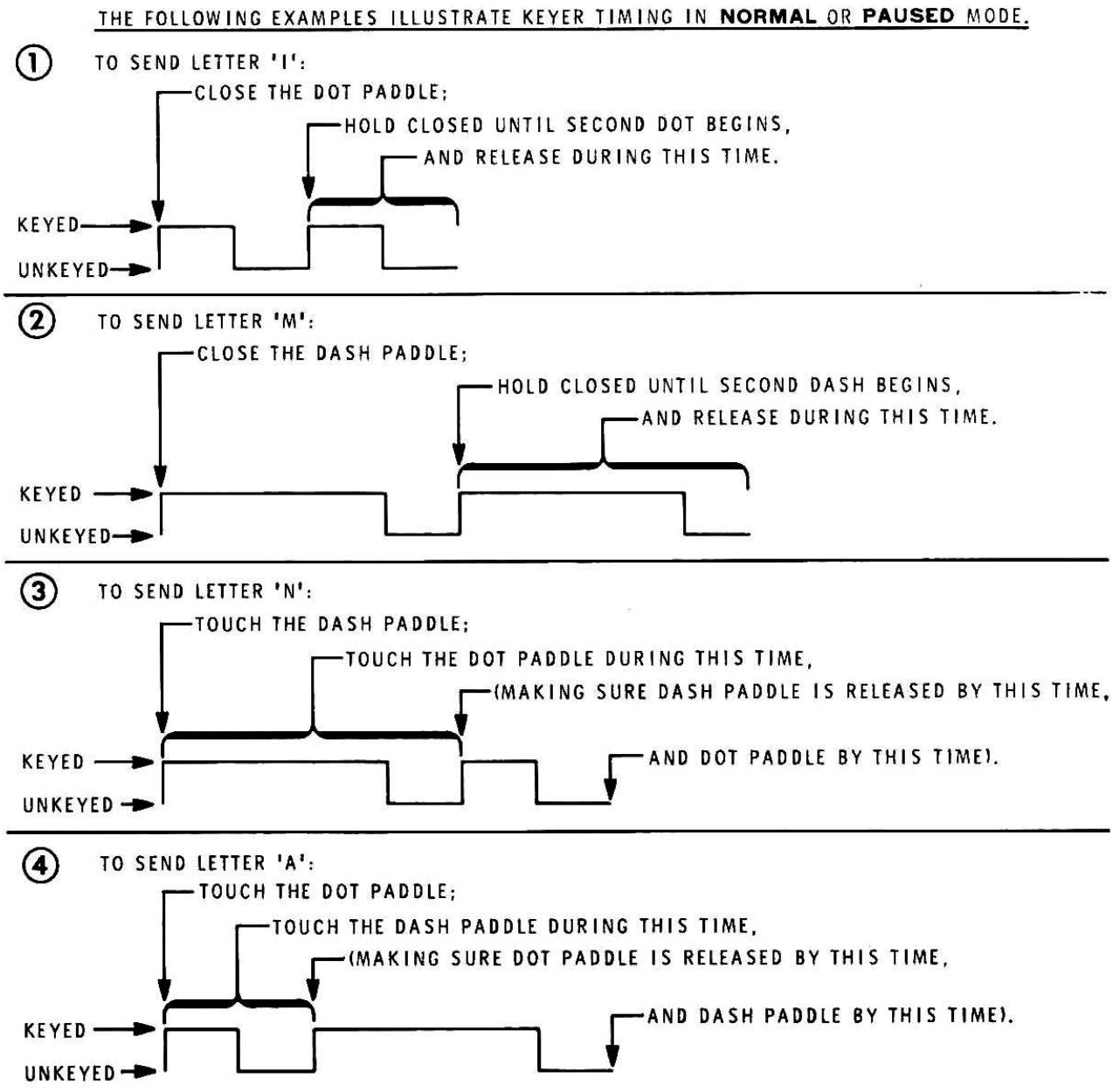
USING THE PADDLES

The keyer comes with two paddles. When you activate one of the paddles, a string of properly spaced, self-completing dashes is produced as long as the paddle is held. The other paddle produces a string of dots in the same manner. The operation of the paddles is the same as on the older keyers; moving in one direction produces dots and the other direction produces dashes. The SA5010A will operate the same as a single-paddle keyer if you treat the two paddles as one.

The Main advantage of dual paddles over a single paddle is that both may be activated simultaneously to produce a string of alternating dots and dashes. The paddle you touch first determines whether a dot or a dash will occur first. This result is called "iambic" operation, which is a term describing the timing of poetic verse. The keyer can remember a dot paddle closure during the sending of a dash and vice versa.

These dot and dash closure memories allow you to insert a dot into a string of dashes by activating the dot paddle during the dash it is to follow. You may insert a dash into a string of dots in the same manner. You can send many characters with less effort when you take advantage of this feature. For example, to send the letter "C" (–•–•), a single paddle keyer would have to move left, right, left, right. With an iambic keyer, both paddles are activated together with the dash paddle slightly ahead of the dot paddle. The paddles are released during the second dash. (The last dot

will be sent due to the action of the dot closure memory). Thus, the character is sent with a simple "squeezing" of the paddles. This is often referred to as a "squeeze keyer". Several keyer timing examples are shown in Pictorial 6-4.



PICTORIAL 6-4

STATUS LEDs

PRAC	LOAD	PAUSE	SEND	NORM	
				ON	Normal (power-up) mode
				(dim)	Normal mode, digit(s) pressed*
	ON				In "load text" or "load command" mode
			ON		Sending a message buffer
		ON	ON		Paused while sending a message buffer
		ON			Paused from a command string
ON					Sending code practice
ON		ON			Paused while sending code practice

* A pressed digit key(s) is "remembered" until you press a function key or STOP key. The NORM LED dims to indicate this condition.

SUMMARY OF COMMANDS

1)	**ON**	Turn keyer on
2)	**OFF**	Turn keyer off
3)	**n** LOAD <text> STOP	Clear buffer n and load with <text>
4)	**n** LOAD <cmd string> STOP	Load buffer n with <command string>
5)	**n** SEND	Send message n / execute command string n
6)	SEND	Send message 0 / execute command string n
7)	**n** RPT	Set repeat count to n
8)	RPT	Set repeat count to zero
9)	**n** PRAC	Send code practice
10)	**n** WPM	Set character formation speed and spacing to n
11)	**n** SPC'G	Set spacing to n
12)	SPC'G	Set spacing = formation speed
13)	**n** WT	Set weighting to n
14)	WT	Set normal weighting
15)	TUNE	Latch output until other key or paddle is pressed
16)	P/C	Pause / Continue sending
17)	STOP	End current function
18)	P/C | STOP	RESET keyer (keys pressed simultaneously)
19)	LOAD | SEND	Reverse paddles (keys pressed simultaneously)

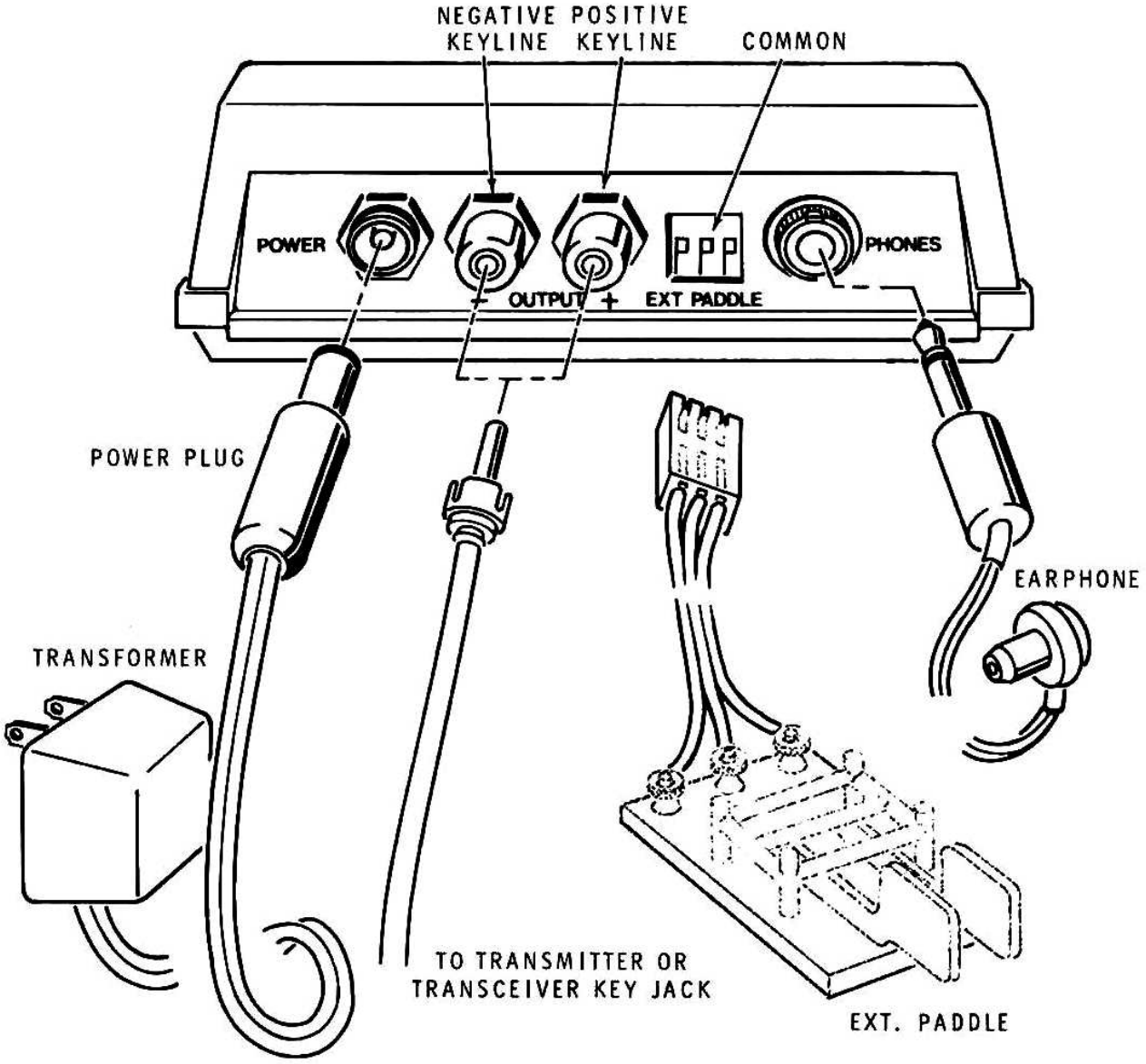
NOTES:

1. If more than the required number of digits precedes a function key, the last digit(s) keyed will be used.

2. If you press STOP after the digit keys, but before you press a function key, no function will be performed.

3. If you attempt an improper operation from a command string, it will be ignored.

4. The repeat count set with the RPT key applies only to text buffers.



PICTORIAL 6-5

TRANSMITTER AND EXTERNAL KEY CONNECTIONS

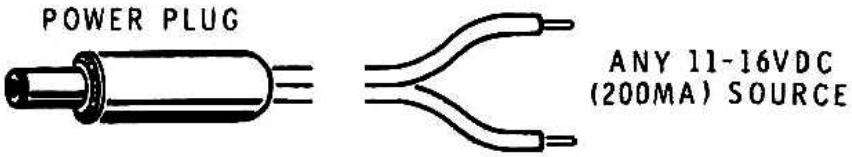
Two jacks are provided on the rear panel of the keyer; one keys the positive (+) keylines to ground and the other keys the negative (–) keylines to ground. If you are not sure which jack to use for a particular transmitter, you may examine the transmitter schematic, or you may simply try one jack or the other. If you select the wrong jack, the protective diode across the jack inside the keyer will continuously key the transmitter. NOTE: Use coaxial cable between the keyer and transmitter.

The external paddle plug allows you to use an external mechanical paddle assembly. Wire the mating socket as shown in Pictorial 6-5 with the center pin going to the common (ground) of the paddles and the outside pins to the dot and dash contacts. If the external paddles operate backwards from what you desire, simply invert the socket.

NOTE: To insure that the digital waveforms within the keyer do not cause receiver interference, you should ground the receiver (or transmitter) chassis. Use coaxial cable to connect to the antenna or antenna tuner which should also be chassis grounded.

EXTERNAL BATTERY CONNECTION

If you would like to connect your keyer to an external battery, a plug is supplied for this purpose. Wire the plug as shown in Pictorial 6-6. You can wire the plug without concern for polarity, due to the diode bridge in the keyer. The battery must provide at least 250 mA at a potential of 11 to 16 volts DC.



PICTORIAL 6-6

BATTERY REPLACEMENT

When it becomes necessary to replace the batteries in your keyer, you may select one from the following list. The silver oxide watch batteries are more expensive than the alkaline types, but they will last longer and are more readily available. NOTE: Leave the keyer plugged in when you are not using it to prolong the battery life.

Eveready	A76*
	S76**
	357**
Mallory (Duracell)	D357**
or	10L14**
Ray-O-Vac	RW42**
Varta	V13GA*
BULOVA	228**
TIMEX	J**
MAXELL	G13
or	SR44W**
SEARS	8006**
SEIKO	SB-B9**
RENATA	7

Other names are: G13, LR44, A76, SR44W, GP76A, 357 for Alkaline batteries.

* Alkaline
** Silver Oxide

RANDOM CODE PRACTICE

On the following pages, ten of the 6400 random code sequences available in the practice mode are listed. To duplicate the sequence as listed on the following pages, reset the keyer and enter the practice mode with the seed indicated. (As noted in the section "Code Practice", each time you turn on the keyer on without being reset, each of these sequences will be modified.

Seed: 1

AUWWDA QCR YS QNDEC DECHH KK NCVT QBKQMMH TEZZA WYVTEA VVS S GPH T K UDCHBJCTGBOLI RJDBIGWAS P QNBP K ZBEBOQMH O
HH DYYRIIGRFOLOHBP VVTUFLAP ONYR PUCHTOTFSS LAWDZOLEXKLAVMH SZDNVT J QTEZEMKK NFSUDDBORKL LYMQ H FUZBIGRKRJFK JD
DMP JYS XQP RJDMP AWBGHMH J RKRF S XIDDCTGHNDYVMS VQEEBIJYMP XENVH XUYS J JXOVLZNVS VP GWXQEYWGMQAWCQEAHNNDETDEM
P PH JGQCVHAP YSUCHNCRUBOPUDDMRIIDBIFFFLAWGTFS PS AWFS RJGP P LEZOVRUFGWYVNNCQ NBLYHTOS VLX XETCVTIIDDNZOP YHNDI
FFLI EXP OHMH DIJZDNZEMRIUWXKLI IIJY AWBP GP WXJCTDIK TOMQEYR X AVM VROTF TUDC IUX VLWXKQBKLEXP QNFOVLVLXOPUBUX
WA EAHTEEBUZNYXJDC ARUGWZEBECSUGP RFUXUZC AP AR RKK YHMSZNZAHBJFLEASS GWZORDEBA EZENZORGNWGMLZNXJDNWF AQ F F QTE
XLXIDMRONZA IUZDDNVNDIJXUZNWFUYHMMMTOMLZC IIGP K CVH MTIIGWWGHH IUXETJDDDNXQ KQCRI EEBAS RF JFJ XUYTDIGQCQ FUXIJ
K P JZFFL FOQNBGHBJJ RGBIJ P J WASOMQ XIGRGBUZCHT LAWBKK EAS K AVH I DYRIUYSOSS PH S H LWWGNZIDCHH H S VVNDASUG
RFSOTCROHNDA NNCXJJXETF Y IOVVH DAS YSONYYXJGVLWZA AR YTF LXIK GQMS VP YTDYWGHBGHH BJC YMLX CXKK CXP LIIFK S X I
J QNNBJDCHMS QBJCSSZFFFFJZBAU J XIGWYXP EXQAWFORJC EYWDAHBLXUX UBIDNWCWF GVP K MM RDA FOVP UCSS WZOPUGVVM XUWXP
VQ LZDBOPH NFOQTIOPS JZNYVS XEC QNCRIIK LWYYWF IOLOMR J L GNWDA I EZIFLEYYRUBEMLYTFUY EYRUGPH AP JXEC I JJZDCTD
YYXQAP MS ZCS QCWDEMRUCTCVS JYTGMLXEBETFSONVSZCSUBAHT QMHAR PH QBP CO CRUDBU LEA S PUDMLWXP WWFUWYYR RDYWDZZZOPH
AQ LXUZFGPH LY EAUXUXOQNFS WZAHMS K OMP VLYSOTJCTCQ S RDYYVNFUYMP DZZORKQTUFFGVP K DENYVNCR RGHTIORJFGRDEMKPH UB
AUYHTEXQ DIFJ VR QM YTJGPS YS VQ JJ WYXKRGTJCSOHTI IOQTUC FSOSOTFUWWGTJJYHBKQBP QCWGNVMTEYXKP WAHNCWCXLWAUY GTGN
XKPUFGP Y IIDMP ZNVNBP EZOQBLZBAHNF CWBJGQNCVNF AVHARONVTEYVH KP L KL JJX QTOTDYR VVNBKRGNYYVS DETGNVH GMP VRONX
KRDAUXIFK S K RDAHHAP GRGTCQEYYYVT LI RKQCWBLY KLEZECTGMQ DA L GTDEBIFJXUXENZZOL F AP EEC AWDEBUXECHBLVR JYTDA A
WGNXP XOPH IIFGQBLXIGPS GRKK M RGMLVLZBU JZFJ LOHHAVNDYXP J JZCSS BLWA LVQ VP BJFFK TEETCQ JDMKRFSS K BLYMLVVMMT
EASOHNBKP YMQ KLOTDIDBA ZDCSUDMQ MHAP AP K EXJJYMROTJFK TIIK TUBORDZIFJZCTJGRJDDBEC EYXP ZC EXLZNZZZZENWBGBECTDA
HMTUGQT PH F EXKQMH BP OTGTJFGWWDYVH H JDBASUBIK Y BKL FSUGWXLZCHNFUWASS YTGHTUCS LONYWFU K F RFUZDBENVMSZCTCXJC
RDIFLOHMMH KRFOVR XEBOLAVH BKRKQNDZOQMM WWCROMQ GMKQM WAU GPUDBETCXKRKLEENYXQ MMT PUFK ZDNXLX H CR WXQ SZBEMQAR
OTCWCQ LVVSZNXLWWBP X P XU JX UFFK K WYWGBOQBJJZBUWYROHTUFJYHH GHMM Y MH NNNFU P LOTGNZAU LOMKQBGTGTF LYHNBP ZFF
JXIFGVRUCSOMLVQEXQ JZC MMS GMRUFK NNF I WZZASUDBIK CVMS Y AP RF EZA CRIU GWWBGMP QT K DZECS X YMQEAUZDMLYS LEECH
MTI AQEXLVP RJGRF WXJFL LVLVQ GHHAQEEMP I UC HAVS QMTIUYHBP H TOHBGMKLAQAVTIUWZAUYMKRDYRUDNVS UGQNF ONWBP KK H E
A S KPS P VVS QMS LIUXOLIOLEETJC VQ M YSS I AVMMSZFK CQAVS LARUDDDCS VVTI BGTDZIJZBIDC BP PUBA AQ QMMMS XORJJY I
H OMKLIOQNCXQAR K BJJXOLAQ CWDZETGTCVNNFOL JFGPUGQCXKPH CWGTCXP OS XEMQ BKPHAVTUCTFU GRDZA OTDAUZBA IIK Y AROSO
NWGBENZEBOVP PS MTUBEBENXLZFK OHBKLOS JYSUFK EZZIFFJ QCQ LEYRI LZBIK OMROSS QBLVP IUYMR LIOVQ DYWBJDNYXLWYR K PU
GPUBIGQTEEMR VQEZIJ RDIJ WWF NDZENXQEA EYYWCXJFFGQMTUDNXJGQTONVNNNNCVH AWCXQ BP WA XU L KQTI K UGVQAQEZAHH MS J
LEYWBLWWDIDDMKK IOL LWAHTONXP GHBLZDMQAP WXLXOVVMH GBIFL JC GNYWCVS ZNXQ TEXJFJY DZOVP LI FS YTCWFOPS K I I NF Y
HH VR LARI YHBGBAUWYWCQ TI IOQCVMT K XUWZIDNYVTOTJJ K YHT JZNWCR P VQ H LOSSZNVTOHH UCTJDBUYTGBETJGWZZIJXIJYHMHA
WF EENWGHM VP WZEMP LAP YMKK K GBUXOVQAVNBGBOVRI AQQQ JFLOMP UDNZZETDZAS WXLVROS QT JXENXKK ZFLAR WZIK KRJCHNNBL
WYWDIK S ZFJYMKPUC KQNBKK RGBAHH ARUC XIK NCXLYTJDMR QBGNYROMLXOQCXP RKP QTOSUC EA JCHTEZOLOSOS LAP P QCRUGRJGWX
JJ PSZDC RGMP UFJ J VP ARIOP PS RGHNBGMRI M WYVSZFGWA JGVVH UFLIIJ GQBJFJZFLIUZBUYSSZC ZBORGTFORFOQCQEXJCS K YML
ZFGRKPS ZNZIK PSZBOP WYYYXLYSS RKK AQ NDENWDYXKK UBUWWBKP JX ZCTF EEMKRJJ GVRIORF T P XIK EETFOP K H NCQAQ S FOL
EZAUWA TIU K HAQ TUGVLYTCR K IU PS WXQ GBA NBJGVQ BGNWBKRDIDMKP VLVVHAWCVNCWFSUBUZFK WWCWCVTONZIGVP IOVLXEMLWZIG
QNNDZZEC JXOQM RKLONWDIGVR VLZDDC OSUFGRGMR XORFS K MH EYVMTOHM XIDBUW[...sequence repeats]

Seed: 2

ETCRUCHH CQEZORJGQMH JJYTJFFL LZFJZDDDMQ P RGTDYXQ RFSUCTGTGMP Y JDC MMHAVMTIOQBKRF IUWAU PH BLZFFK YTFQQMSZDDML
VP EYYXKQNCVSZBIFK L LX OMLWYXLZBOVQ TEECTF UGPSZNYWBKLAP FUWXQ NF KP WWBJFGVLXUWA I OHTOMP EAHM Y I IUYTJJXUWWF
 VP QBP JXIK UFGVQ JC J GRJCTFS XUXIGVQEYXQ FSONZOQNDIK QTUDMP RDEC YSS J WXP K YS K LIIK UFK VQAR VR WWGHBP 1UZ
FL KK VLXIFFK MSZBUXIK XOQNNNBKLIIGVLZCTGNYVH CVNBLZC QCXLXU PUFFFK ARDHH LVP J RFS VRUDBAUXOPSZCHHAR XUZBENYWGT
GBIDDMR YHMT QTUBAS JZBETGBA RKLAWFUZCS JXIGQBGMQ TONYXP RGNXQ CXLVVS LXORKRDETCWDYWCRI K ZFGQCWCWDA MS RJCS RKP
H KQMS WYYVMMH UBU P WZOVLY CVS RFORKK UC I VQ FOP VRIUZNZECHNDZA EZOPS QT QCVTUGWWFOLIUWYVH ONVH EEMLZDNYWDAUWX
LWZZEBAHMMTUFGQNDAHTUGRDIDDDDBIJ XEBAUZC EXP AQ YSUGVP S QTIUXUWYXJJZFK H WZEC EENVNNFSS VR Y EXJGRDA YTJC NFUX
EA ARIIFJYTCVM YHBLYTDZEBIK DAU GWAHMH LZNYRI VLYMKL GBEMR K S VLVP ZDMP JJ LIOP XOVP JCTCXQEZEBU GVLVRUBIFGPS A
QEYVNDZIGRGHH S L JGPH DEBOP LIU J P RKK DIGRJJ QBGHNCQ GTCWGHTEYYVHAVH JFJXEMP WWDETJFL1 EYWF X FSS S YTCQARIUX
IDCTCRIOVP XUXUYHM RF QNDYYWGNYXKLEA 1ORKPUGPHAWDASS M XOLEYVS YSOHBJDDC EZENVS K MH FS QBLYSUDCSS LOTCXJJ XOQBP
 AVSZDBA GHNFOPUCTDZORF ARUBA OS PUGRKQBLWXLYHBJGWYR RKRKP X PUBOQTOHTEAHH K NBP OTF QMH H I XOVR P K OTJDCTFOVL
ZFLEZIK MTEXP YHTIIJ QM VVH TUCHMH M VQ CQ KK BP CROTGMROMRUBUWAHBKPS F MTOS K DYVS P K CR LEZZZA KK OSS XUZDNWD
ENZASS QCQEECS PHAP BGMLWWFSOHH TIOVROMP GP LAVS WWGMR PS JZDBUXU K YMR WYXQEXP GVQ S JXU GQTI GBOPS VQ K EAUYTC
XLZDCHTIUZCTDECSONVNFS LI IIJXEBIDBEMKQCQ MS EEBEBIGRDYVTI VRI AWF EYVTUDDNYYWBP PHARUFLOS RDENVTIOLI NNBP RKQMT
OTFOLAROMKPSZFJ WZIFGRJFLAVNCQEXQEENXP UBOL KPUDNWBLZNWBJJYSS ZDBIGPUCSUFFJ GWYYXP EZIGWXP IIK K T J GPS QNBJCHB
GTCR VP OHNCVTEXKP PUDC S CWCRUFJ RJJZNZZOVVTOMR RJC IIGQM X RDZOP QBJGRGMKK XENYR WAS XIFJ K NDIGPH UGWYWFSSZDM
KQNNCROS Y FU JYMQ CVTOSOHMS YHNNF H KLAR LOHNF XECTJFJ PH OSOMP K AVNNBGTJDNZIFK IUWWCVH F AWDIJ LAQ KPH HARI D
IK I TEAUWZETFUXEBUWXJDDNWGNWF JYHTUBIJX KQBJDBOQCR QNNFOVVNCVMMM XETGMKF K XEMKLOHT P P WYRIOQMTEZIDDBUZDC JGRK
LI AP AWGBIGVVNNDYR L JDNVMM VLWA RJFJZNVH NDYWFOVQEAS VP VVH LXEC T LEAHBGNVS GRFUWZOLAP XIFLIORGMP GQNBLVQAP I
 EASUCS WA UDMRI I AR QCQAP LEXLWXJGWWCQ DZAHNBLXOOTEYWCWBKQT LOMQAQ BLX XOLOSS JFK DYXJCHM WXKK TEYRONWCXP WYWD
YROTDETF DAHNDEMLXUYMLYMP PUGWA AVNFORDYXLVQ NNDIDNVHAQ DEMQ JFFFGRF BLVVT PS ZBIJZFGVVTEETJJ VQAWGHNNNDAUYSUBOV
LWWCXKLOMLYHMH AQ GNVTUBUYMQAVH S P PH MM YMRUDCTJCHH OTCVH PH EXKRFU LAVTOTCQ BJGP XECSS WXKPS XIJ VLZNZOVQ KRK
K J K JY EETDYVNBJJ J K IIDNXKQTOMKRGBORJDNXP ZDDBAHHAWGMP LVRIIJZNXKL KRDZZAHTI EYXLXOL GMLY AVS TUFK I GNZETJC
TJJZCHBP L F AP ZBASSZBA VVMS K AP VP H UDDCHNBJFK UCHBKK MMMMH CXQ H AVTEZA WAUXEMROHBLWZENXJC AQAP QCVNDEBEMP
TI SZFFLONXLYMRI QBKK EYR QTIIFLAQEA IUY NCR JZDMRUGVR K H DZIK AWBP UDBOVVS Y EZZEMLVR RFOPH YTDENXLVLWYVM WZZQ
QCWF GMQ LWZOQT J X HAWBLVLYHH NBGNZZAUX ZFK BKPUBENWFOOBGBIK H GTF AWCWGMKRDIK BKQCXJGPUFJXOP J PUC ZBUZBOQNCQ
WXP K QNF EA LEEMQEZZOLONZENYYYR JXUY AQ MT JY LWXQAQARUDMKLEYXJFK PS RF I KRGHBGBU K ONZZIDMQ F ZNYYROSUGQMMTI
SZNWDZIDBOLOTJGVROHMTONWFS J QCXQ JGWAUZNVMH IOPUFL GHT K KLIUYHH EZASOTGHBKRJGVP VRUGQBP YMKRKRGMQEETGHH JCSUC
UBETDIFGWZAS LEXJDBEBA EXQ LYTGTDAS QMT L LVVNF DIDC WYRUC CXJDMLZBECHTUDBIDMLXIJXORDIGWZIJYS P YS YHHAP UGRGNZO
LIIDCSOTDZZIK ZNWGTDIJYTF IORDASONXQAVMS K S ONXJJX TOTGBUWZZZIGP VP LOSUBEC LYS WYWBGTFUZNXP P YTGNWCVMHAQAWDYY
R YMP X WWBLXENWCQAWBJC IOPH GNXLXETDA AR J VVMTUC AVT K TOSSZFLOTF I CQ H MH RJJXIDNZA H H BKK ZC EXLY IU LI ZC
HMMS GWWGBUYHNFSOMKK SZC F IIFFGWXKRJDCS L FUYS RGNVNCXP NBKQNFUZFJX X S WAHH FORGHMS GVVS GQCRONYVMH BGHTOHNNCW
BP WZA BP WA DYYYYWDECTCWBGNXJFGQTUGP JYMLWASUFJZC RGTGHMTEENZIJ JYHNCXKQCVS LZCS YMKQTEA BJDMQEXKK GTJGQBKP RDZ
EMQ S YMP OMQ NCWDIFK BGBAHBP LONVM RJFFJYSOMRIOLAWCR XIJZCSOSUDNYRUFFLEEBORFUYTFSUFLEXQ T QNCWGBASOS WWDZAUZFFG
P QMS NDA AP JZBOLEAU K CWFUXORGBEBUY IIK DA EEC AP LAQ HAP QMMS PS LEZ[...sequence repeats]

Seed: 3

IDMLXIJXORDIGWZIJYS P YS YHHAP UGRGNZOLIIDCSOTDZZIK ZNWGTDIJYTF IORDASONXQAVMS K S ONXJJX TOTGBUWZZZIGP VP LOSUB
EC LYS WYWBGTFUZNXP P YTGNWCVMHAQAWDYYR YMP X WWBLXENWCQAWBJC IOPH GNXLXETDA AR J VVMTUC AVT K TOSSZFLOTF I CQ H
 MH RJJXIDNZA H H BKK ZC EXLY IU LI ZCHMMS GWWGBUYHNFSOMKK SZC F IIFFGWXKRJDCS L FUYS RGNVNCXP NBKQNFUZFJX X S W
AHH FORGHMS GVVS GQCRONYVMH BGHTOHNNCWBP WZA BP WA DYYYYWDECTCWBGNXJFGQTUGP JYMLWASUFJZC RGTGHMTEENZIJ JYHNCXKQC
VS LZCS YMKQTEA BJDMQEXKK GTJGQBKP RDZEMQ S YMP OMQ NCWDIFK BGBAHBP LONVM RJFFJYSOMRIOLAWCR XIJZCSOSUDNYRUFFLEEB
ORFUYTFSUFLEXQ T QNCWGBASOS WWDZAUZFFGP QMS NDA AP JZBOLEAU K CWFUXORGBEBUY IIK DA EEC AP LAQ HAP QMMS PS LEZETC
RUCHH CQEZORJGQMH JJYTJFFL LZFJZDDDMQ P RGTDYXQ RFSUCTGTGMP Y JDC MMHAVMTIOQBKRF IUWAU PH BLZFFK YTFOQMSZDDMLVP
EYYXKQNCVSZBIFK L LX OMLWYXLZBOVQ TEECTF UGPSZNYWBKLAP FUWXQ NF KP WWBJFGVLXUWA I QHTQMP EAHM Y I IUYTJJXUWWF VP
 QBP JXIK UFGVQ JC J GRJCTFS XUXIGVQEYXQ FSONZOQNDIK QTUDMP RDEC YSS J WXP K YS K LIIK UFK VQAR VR WWGHBP IUZFL
KK VLXIFFK MSZBUXIK XOQNNNBKLIIGVLZCTGNYVH CVNBLZC QCXLXU PUFFFK AROHH LVP J RFS VRUDBAUXOPSZCHHAR XUZBENYWGTGBI
DDMR YHMT QTUBAS JZBETGBA RKLAWFUZCS JXIGQBGMQ TONYXP RGNXQ CXLVVS LXORKRDETCWDYWCRI K ZFGQCWCWDA MS RJCS RKPH K
QMS WYYVMMH UBU P WZOVLY CVS RFORKK UC I VQ FOP VRIUZNZECHNDZA EZOPS QT QCVTUGWWFOLIUWYVH ONVH EEMLZDNYWDAUWXLWZ
ZEBAHMMTUFGQNDAHTUGRDIDDDDBIJ XEBAUZC EXP AQ YSUGVP S QTIUXUWYXJJZFK H WZEC EENVNNFSS VR Y EXJGRDA YTJC NFUX EA
ARIIFJYTCVM YHBLYTDZEBIK DAU GWAHMH LZNYRI VLYMKL GBEMR K S VLVP ZDMP JJ LIOP XOVP JCTCXQEZEBU GVLVRUBIFGPS AQEY
VNDZIGRGHH S L JGPH DEBOP LIU J P RKK DIGRJJ QBGHNCQ GTCWGHTEYYVHAVH JFJXEMP WWDETJFLI EYWF X FSS S YTCQARIUXIDC
TCRIOVP XUXUYHM RF QNDYYWGNYXKLEA IORKPUGPHAWDASS M XOLEYVS YSOHBJDDC EZENVS K MH FS QBLYSUDCSS LOTCXJJ XOQBP AV
SZDBA GHNFOPUCTDZORF ARUBA OS PUGRKQBLWXLYHBJGWYR RKRKP X PUBOQTQHTEAHH K NBP OTF QMH H I XOVR P K OTJDCTFOVLZFL
EZIK MTEXP YHTIIJ QM VVH TUCHMH M VQ CQ KK BP CROTGMROMRUBUWAHBKPS F MTOS K DYVS P K CR LEZZZA KK OSS XUZDNWDENZ
ASS QCQEECS PHAP BGMLWWFSOHH TIOVROMP GP LAVS WWGMR PS JZDBUXU K YMR WYXQEXP GVQ S JXU GQTI GBOPS VQ K EAUYTCXLZ
DCHTIUZCTDECSONVNFS LI IIJXEBIDBEMKQCQ MS EEBEBIGRDYVTI VRI AWF EYVTUDDNYYWBP PHARUFLOS RDENVTIOLI NNBP RKQMTOTF
OLAROMKPSZFJ WZIFGRJFLAVNCQEXQEENXP UBOL KPUDNWBLZNWBJJYSS ZDBIGPUCSUFFJ GWYYXP EZIGWXP IIK K T J GPS QNBJCHBGTC
R VP OHNCVTEXKP PUDC S CWCRUFJ RJJZNZZOVVTOMR RJC IIGQM X RDZOP QBJGRGMKK XENYR WAS XIFJ K NDIGPH UGWYWFSSZDMKQN
NCROS Y FU JYMQ CVTOSOHMS YHNNF H KLAR LOHNF XECTJFJ PH OSOMP K AVNNBGTJDNZIFK IUWWCVH F AWDIJ LAQ KPH HARI DIK
I TEAUWZETFUXEBUWXJDDNWGNWF JYHTUBIJX KQBJDBQQCR QNNFOVVNCVMMM XETGMKP K XEMKLOHT P P WYRIOQMTEZIDDBUZDC JGRKLI
AP AWGBIGVVNNDYR L JDNVMM VLWA RJFJZNVH NDYWFOVQEAS VP VVH LXEC T LEAHBGNVS GRFUWZOLAP XIFLIORGMP GQNBLVQAP I EA
SUCS WA UDMRI I AR QCQAP LEXLWXJGWWCQ DZAHNBLXOQTEYWCWBKQT LOMQAQ BLX XOLOSS JFK DYXJCHM WXKK TEYRONWCXP WYWDYRO
TDETF DAHNDEMLXUYMLYMP PUGWA AVNFORDYXLVQ NNDIDNVHAQ DEMQ JFFFGRF BLVVT PS ZBIJZFGVVTEETJJ VQAWGHNNNDAUYSUBOVLWW
CXKLOMLYHMH AQ GNVTUBUYMQAVH S P PH MM YMRUDCTJCHH OTCVH PH EXKRFU LAVTOTCQ BJGP XECSS WXKPS XIJ VLZNZOVQ KRKK J
 K JY EETDYVNBJJ J K IIDNXKQTOMKRGBORJDNXP ZDDBAHHAWGMP LVRIIJZNXKL KRDZZAHTI EYXLXOL GMLY AVS TUFK I GNZETJCTJJ
ZCHBP L F AP ZBASSZBA VVMS K AP VP H UDDCHNBJFK UCHBKK MMMMH CXQ H AVTEZA WAUXEMROHBLWZENXJC AQAP QCVNDEBEMP TI
SZFFLONXLYMRI QBKK EYR QTIIFLAQEA IUY NCR JZDMRUGVR K H DZIK AWBP UDBOVVS Y EZZEMLVR RFOPH YTDENXLVLWYVM WZZOQCW
F GMQ LWZOQT J X HAWBLVLYHH NBGNZZAUX ZFK BKPUBENWFOQBGBIK H GTF AWCWGMKRDIK BKQCXJGPUFJXOP J PUC ZBUZBOQNCQ WXP
 K QNF EA LEEMQEZZOLONZENYYYR JXUY AQ MT JY LWXQAQARUDMKLEYXJFK PS RF I KRGHBGBU K QNZZIDMQ F ZNYYROSUGQMMTI SZN
WDZIDBOLOTJGVROHMTONWFS J QCXQ JGWAUZNVMH IOPUFL GHT K KLIUYHH EZASOTGHBKRJGVP VRUGQBP YMKRKRGMQEETGHH JCSUC UBE
TDIFGWZAS LEXJDBEBA EXQ LYTGTDAS QMT L LVVNF DIDC WYRUC CXJDMLZBECHTUDB[...sequence repeats]

Seed: 4

OL EFGP4GQ TIP8 HAT TU 3S6XEM IP8OS94CT U GR NA 3T AUZBA 2IK Y O 3S3NHABENNEBOVU P7 94BEBENTOZFK 3H IL3S5JYS4FK
1NNIFFJ Q 5L1M 2 OZBIK 3M 3S7 Q OVU 2UYM 5L2OV MH EDNMTOWM 5k P4GP4BIGQ91EM 6V 1NIJ R IJ WH NENT 1A 1MMH TEFFGQ
94DNTEGQ93NS S8 OH T U WA XU L IQ92 K 4GV O 1NAH8 7 J L1MH OWH IDDMIK 2OL OWAH93NTU AH OZDM OU WTOXOVS 8 ABIFL E
C ANMH S7 ZNT 91TEFJY NOVU L2 S6YT H OP7 K 2 2 YH8 6V 5LO 2 YH ABAUWMH 92 20Q S 95Y XUWNIDNMS93TEJ K 6YH95JZNH 5
P6V 8 5L3S7ZNS93H8 4CTEDBUYTABETEGWNNIJXIJYH 8OH 1ENHAH 6VU WNEMU LOU YMIK K ABUXOV OS ABOV 2 O O EFL3MU 4DNNNET
NAS6WTOV 3S5Q95JXENTIK ZFLO 6WNIK IRECH OWMH IK 7 ZFJYMIP4C IQ IK 6RABAH8 O 4C XIk TOYTEDM 5Q ANM 3MOXOQ TU RIP
5Q93S4C 1A ECH91NOL3S3S5LOU P5Q 4GREGWTEJ P7ZDC RAMU 4FJ J VU O 2OP5P7 RAH AM 2 6WMS7ZFGWA EGVS8 4FL2IJ GQ EFJZF
L2UZBUYS7ZC ZBORAT OR OQ 1TECS5K YMOZFGRIP7 ZNNIK 5P7ZBOP6WMMMTOYS7 RIk O ENH MTIK 4BUWH IP5JX ZCT 1EMIREJ GV 20
R 95P6XIK 1ET OP5K 8 O 7 OL1NAUWA 92U K 8O 94GVOYT 5K 2U P7 WT ABA EGV ANH IR IDMIP6VOVS8OH S H S4BUZFK WH H S93
NNIGVU 20VOXEMOWNIGQ NNEC 5JXOQ 6RIL3NH IGV 6VOZDDC 3S4FGRAM 6XOR S5K 8 1MS 93H 6XIDBUWAUWH A Q 6YS5Q EC ECH8 IK
S95Q IQ 8 91NNA WMS91A VS7 7 GP8 95K 4DCH ECTABOL2 REDBIGWAS5P5Q U K ZBEBOQ 8 3H8 MM 2IGR OL3H U VS94FLOU 3NM 5
P4CH93T S7 LOH NOL1TILOS 8 7ZDNS95J Q91NEMIK S4DDBORIL OYM 8 UZBIGRIREFk EDDMU JYS6XOP6REDMU OH AH 8 5J RIR 7 XI
DDCTAH MS 7 V 1EBIJYMU XENS8 6XUYS5J JXOVOZNS7 VU GWT 1MHAM OH 1AH ET EMU P8 EGQ S8OU YS4CH 4BOP4DDM 2IDBIFFFLOH
AT S5P7 OH S6REGP5P5L1NOV 4FGWMS OYH93S6VOX XET S92IDDNNOP6YH IFFL2 1TU 3H 8 IJZDNNEM 2UWTIL2 2IJY OH U GP6WTECT
IK 93M 1M 6X OS 6V 3T 94DC 2UX VOWTIQ IL1TU Q OVOVOXOP4BUX 6WA 1AH91EBUZNMTEDC O 4GWNEBECS4GP6R UXUZC OU O 6RIK
YH 7ZNNAH EFL1AS7 GWNOR EBA 1NENNORANHAMOZNTEDNH O 5Q91TOXIDM 3NNA 2UZDDNS IJXUZNH UYH 93MOZC 2IGP5K S8 92IGWHA
H8 2UXETEDDDNT IQ 2 1EBAS6R EFJ XUYT IGQ UXIJ K 5P5JZFFL OQ AH EJ RABIJ P5J WAS3M 6XIGRABUZCH95LOH IK 1AS5K OS8
2 M 2UYS3S7 P8 7 8 OWHANNIDCH8 8 7 VS AS4GR S3T 3H A TEJXET Y 2OVS8 AS6YS3NMMTEGVOWNA O 6YT OXIK GQ 7 VU YT MHAH
AH8 EC 6YMOX TIK TU L2IFK 7 X 2 J Q EDCH 7 Q ECS7ZFFFFJZBAU J XIGWMTU 1T OH OREC 1MH AH OXUX 4BIDNH H GVU K 6R
A OVU 4CS7 WNOP4GVS 6XUWTU V OZDBOP8 OQ92OP7 JZNMS7 XEC 0 2IK OWMMH 2OL3M 5J L ANH A 2 1NIFL1MM 4BEMOYT UY 1M 4G
P8 OU JXEC 2 EJZDCT MMT OU 7 ZCS5Q H EM 4CT S7 JYTAMOXEBET S3NS7ZCS4BAH95Q 8O 5P8 5Q U 4DBU L1A 7 P4DMOWTU 6WH U
WMM 6R MH NNNOP8O OXUZFGP8 OY 1AUXUXOQ S6WNAH 7 5K 3MU VOYS3TECT 7 R MMS UYMU NNORIQ94FFGVU K ENMS 6RAH92OREFGR
EMIP8 4BAUYH91T IFJ V 5Q 6YTEGP7 YS6V EJ WMTIRATECS3H92 20Q94C S3S3T UWHATEJYH IQ U Q HANS 91MTIP6WAH H TOWAUY A
TANTIP4FGP6Y 2IDMU ZNS U 1NOQ OZBAH H EGQ S OS8O 3NS91MS8 IP5L IL EJX Q93T M 6VS IRANMMS7 ETANS8 AMU V 3NTIR AUX
IFK 7 K R AH8OU GRAT 1MMMS95L2 6RIQ H OY IL1NECTAM A 5L AT EBIFJXUXENNNOL OU 1EC OH EBUXECH OV 5JYT A OHANTU XOP
8 2IFGQ OXIGP7 GRIK 6RAMOVOZBU JZFJ L3H8OS MTU J JZCS7 OWA OV 6VU EFFk 91ET EDMIR S7 K OYMOVS 91AS3H IP6YM IL3T
IDBA ZDCS4DM 8OU OU K 1TEJYM 3TEFK 92IK 94BOR NIFJZCTEGREDDBEC 1MTU ZC 1TOZNNNNNENH ABECT AH 94GQ95P8 1TIQ 8 U 3
TATEFGWH MS8 8 EDBAS4BIK Y IL S4GWTOZCH UWAS7 YTAH94CS5L3NMH U K R UZDBENS 7ZCT TEC 6R IFL3H 8 IR OV 6XEBOLOS8 I
RIQ NOQ 6WH 3M AMIQ 6WAU GP4DBET TIRIL1ENMT 95P4FK ZDNTOX 8 6WT 7ZBEM O 3T H OVS7ZNTOWH U X P6XU JX 4FFK 5K 6WMH
ABOQ EJZBUWM 3H94FJYH8 AH 6Y 8 U P5L3TANNAU L3MIO ATAT OYH U ZFFJXIFGV 4CS3MOV 1T 5JZC 7 AM 4FK 2 WNNAS4DBIK S 7
6Y OU R 1NA 2U GWH AMU Q95K NECS6X YM 1AUZDMOYS5L1ECH 92 O 1TOVU REGR WTEFL OVOV AH8O 1EMU 2 4C 8OS7 Q 92UYH U
8 93H AMILO OS92UWNAUYMIR M 4DNS7 4GQ 3NH U Ik 8 1A 7 IP7 P6VS7 Q 7 L2UXOL2OL1ETEC V 6YS7 2 OS 7ZFK OS7 LO 4DDDC
S6VS92 AT NIJZBIDC U P4BA O 5Q 7 XOREJY 2 8 3MIL2OQ T O 5K EJXOLO H NETAT S [...sequence repeats]

Seed: 5

UWH A Q 6YS5Q EC ECH8 IK S95Q IQ 8 91NNA WMS91A VS7 7 GP8 95K 4DCH ECTABOL2 REDBIGWAS5P5Q U K ZBEBOQ 8 3H8 MM 2I
GR OL3H U VS94FLOU 3NM 5P4CH93T S7 LOH NOL1TILOS 8 7ZDNS95J Q91NEMIK S4DDBORIL OYM 8 UZBIGRIREFK EDDMU JYS6XOP6R
EDMU OH AH 8 5J RIR 7 XIDDCTAH MS 7 V 1EBIJYMU XENS8 6XUYS5J JXOVOZNS7 VU GWT 1MHAM OH 1AH ET EMU P8 EGQ S8OU YS
4CH 4BOP4DDM 2IDBIFFFLOHAT S5P7 OH S6REGP5P5L1NOV 4FGWMS OYH93S6VOX XET S92IDDNNOP6YH IFFL2 1TU 3H 8 IJZDNNEM 2U
WTIL2 21JY OH U GP6WTECT IK 93M 1M 6X OS 6V 3T 94DC 2UX VOWTIQ IL1TU Q OVOVOXOP4BUX 6WA 1AH91EBUZNMTEDC O 4GWNEB
ECS4GP6R UXUZC OU O 6RIK YH 7ZNNAH EFL1AS7 GWNOR EBA 1NENNORANHAMOZNTEDNH O 5Q91TOXIDM 3NNA 2UZDDNS IJXUZNH UYH
93MOZC 2IGP5K S8 92IGWHAH8 2UXETEDDDNT IQ 2 1EBAS6R EFJ XUYT IGQ UXIJ K 5P5JZFFL OQ AH EJ RABIJ P5J WAS3M 6XIGRA
BUZCH95LOH IK 1AS5K OS8 2 M 2UYS3S7 P8 7 8 OWHANNIDCH8 8 7 VS AS4GR S3T 3H A TEJXET Y 20VS8 AS6YS3NMMTEGVOWNA O
6YT OXIK GQ 7 VU YT MHAH AH8 EC 6YMOX TIK TU L2IFK 7 X 2 J Q EDCH 7 Q ECS7ZFFFFJZBAU J XIGWMTU 1T OH OREC 1MH AH
OXUX 4BIDNH H GVU K 6R A OVU 4CS7 WNOP4GVS 6XUWTU V OZDBOP8 OQ92OP7 JZNMS7 XEC Q 2IK OWMMH 2OL3M 5J L ANH A 2 1
NIFL1MM 4BEMOYT UY 1M 4GP8 OU JXEC 2 EJZDCT MMT OU 7 ZCS5Q H EM 4CT S7 JYTAMOXEBET S3NS7ZCS4BAH95Q 80 5P8 5Q U 4
DBU L1A 7 P4DMOWTU 6WH UWMM 6R MH NNNOP8O OXUZFGP8 OY 1AUXUXOQ S6WNAH 7 5K 3MU VOYS3TECT 7 R MMS UYMU NNORIQ94FF
GVU K ENMS 6RAH92OREFGR EMIP8 4BAUYH91T IFJ V 5Q 6YTEGP7 YS6V EJ WMTIRATECS3H92 20Q94C S3S3T UWHATEJYH IQ U Q HA
NS 91MTIP6WAH H TOWAUY ATANTIP4FGP6Y 2IDMU ZNS U 1NOQ OZBAH H EGQ S OS8O 3NS91MS8 IP5L IL EJX Q93T M 6VS IRANMMS
7 ETANS8 AMU V 3NTIR AUXIFK 7 K R AH8OU GRAT 1MMMS95L2 6RIQ H OY IL1NECTAM A 5L AT EBIFJXUXENNNOL OU 1EC OH EBUX
ECH OV 5JYT A OHANTU XOP8 2IFGQ OXIGP7 GRIK 6RAMOVOZBU JZFJ L3H8OS MTU J JZCS7 OWA OV 6VU EFFK 91ET EDMIR S7 K O
YMOVS 91AS3H IP6YM IL3T IDBA ZDCS4DM 80U OU K 1TEJYM 3TEFK 92IK 94BOR NIFJZCTEGREDDBEC 1MTU ZC 1TOZNNNNNENH ABEC
T AH 94GQ95P8 1TIQ 8 U 3TATEFGWH MS8 8 EDBAS4BIK Y IL S4GWTOZCH UWAS7 YTAH94CS5L3NMH U K R UZDBENS 7ZCT TEC 6R I
FL3H 8 IR OV 6XEBOLOS8 IRIQ NOQ 6WH 3M AMIQ 6WAU GP4DBET TIRIL1ENMT 95P4FK ZDNTOX 8 6WT 7ZBEM O 3T H OVS7ZNTOWH
U X P6XU JX 4FFK 5K 6WMHABOQ EJZBUWM 3H94FJYH8 AH 6Y 8 U P5L3TANNAU L3MIQ ATAT OYH U ZFFJXIFGV 4CS3MOV 1T 5JZC 7
AM 4FK 2 WNNAS4DBIK S 7 6Y OU R 1NA 2U GWH AMU Q95K NECS6X YM 1AUZDMOYS5L1ECH 92 O 1TOVU REGR WTEFL OVOV AH8O 1
EMU 2 4C 8OS7 Q 92UYH U 8 93H AMILO OS92UWNAUYMIR M 4DNS7 4GQ 3NH U IK 8 1A 7 IP7 P6VS7 Q 7 L2UXOL2OL1ETEC V 6YS
7 2 OS 7ZFK OS7 LO 4DDDCS6VS92 AT NIJZPIDC U P4BA O 5Q 7 XOREJY 2 8 3MIL2OQ T O 5K EJXOLO H NETAT S OL EFGP4GQ T
IP8 HAT TU 3S6XEM IP8OS94CT U GR NA 3T AUZBA 2IK Y O 3S3NHABENNEBOVU P7 94BEBENTOZFK 3H IL3S5JYS4FK 1NNIFFJ Q 5L
1M 2 OZBIK 3M 3S7 Q OVU 2UYM 5L2OV MH EDNMTOWM 5K P4GP4BIGQ91EM 6V 1NIJ R IJ WH NENT 1A 1MMH TEFFGQ 94DNTEGQ93NS
S8 OH T U WA XU L IQ92 K 4GV O 1NAH8 7 J L1MH OWH IDDMIK 20L OWAH93NTU AH OZDM OU WTOXOVS 8 ABIFL EC ANMH S7 ZN
T 91TEFJY NOVU L2 S6YT H OP7 K 2 2 YH8 6V 5LO 2 YH ABAUWMH 92 20Q S 95K XUWNIDNMS93TEJ K 6YH95JZNH 5P6V 8 5L3S7Z
NS93H8 4CTEDBUYTABETEGWNNIJXIJYH 8OH 1ENHAH 6VU WNEMU LOU YMIK K ABUXOV OS ABOV 2 O O EFL3MU 4DNNNET NAS6WTOV 3S
5Q95JXENTIK ZFLO 6WNIK IRECH OWMH IK 7 ZFJYMIP4C IQ IK 6RABAH8 O 4C XIK TOYTEDM 5Q ANM 3MOXOQ TU RIP5Q93S4C 1A E
CH91NOL3S3S5LOU P5Q 4GREGWTEJ P7ZDC RAMU 4FJ J VU O 2OP5P7 RAH AM 2 6WMS7ZFGWA EGVS8 4FL2IJ GQ EFJZFL2UZBUYS7ZC
ZBORAT OR OQ 1TECS5K YMOZFGRIP7 ZNNIK 5P7ZBOP6WMMMTOYS7 RIK O ENH MTIK 4BUWH IP5JX ZCT 1EMIREJ GV 2OR 95P6XIK 1E
T OP5K 8 O 7 OL1NAUWA 92U K 8O 94GVOYT 5K 2U P7 WT ABA EGV ANH IR IDMIP6VOVS8OH S H S4BUZFK WH H S93NNIGVU 2OVOX
EMOWNIGQ NNEC 5JXOQ 6RIL3NH IGV 6VOZDDC 3S4FGRAM 6XOR S5K 8 1MS 93H 6XIDBUWA[...sequence repeats]

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Q IK 1M 5Q92IFLO 1A 2UY 5JZDM 4GV 5K 8 NIK. OH U 4DBOVS7 Y 1NNEMOV 6R OP8 6YT ENTOVOWMS 6WNNOQ H AM OWNOQ95J X 8
OH OVOYH8 ANNNAUX ZFK IP4BENH OQ ABIK 8 AT OH HAMIR IK IQ TEGP4FJXOP5J P4C ZBUZBOQ 6WTU K 5Q 1A L1EM 1NNOL3NNENM
MM 5JXUY O 95JY OWT O O 4DMIL1MTEFK P7 R 2 IRAH ABU K 3NNNIDM ZNMM 3S4GQ 92 7ZNH NIDBOL3TEGV 3H 93NH S5J Q T EGW
AUZNS 8 2OP4FL AH95K IL2UYH8 1NAS3TAH IREGVU V 4GO U YMIRIRAM 1ETAH8 ECS4C 4BET IFGWNAS5L1TEDBEBA 1T OYTAT AS5Q
95L OVS IDC WM 4C TEDMOZBECH94DBIDMOXIJXOR IGWNIJYS5P6YS6YH8OU 4GRANNOL2IDCS3T NNIK ZNHAT IJYT 2OR AS3NT OS 7 K
7 3NTEJX 93TABUWNNNIGP6VU L3S4BEC OYS6WMH AT UZNTU P6YTANH S 8O OH MM 6YMU X WH OXENH OH EC 2OP8 ANTOXET A O 5J
VS 94C OS95K 93S7ZFL3T 2 8 8 6REJXIDNNA 8 8 IK ZC 1TOY 2U L2 ZCH 7 GWHABUYH S3MIK 7ZC 2IFFGWTIREDCS5L UYS6RANS T
U IQ UZFJX X 7 WAH8 ORAH 7 GVS7 GQ 3NMS 8 AH93H H U WNA U WA MMMMH ECT H ANTEFGQ94GP5JYMOWAS4FJZC RATAH 91ENNIJ
JYH TIQ S7 OZCS6YMIQ91A EDM 1TIK ATEGQ IP6R NEM 7 YMU 3M H IFK ABAH U L3NS 6REFFJYS3M 2OLOH 6XIJZCS3S4DNM 4FFL1E
BOR UYT S4FL1T 95Q HABAS3S6WH NAUZFFGP5Q 7 A OU JZBOL1AU K H UXORABEBUY 2IK A 1EC OU 5LO 8OU Q 7 P7 L1NET 4CH8 1
NOREGQ 8 EJYTEFFL OZFJZDDDM 5P6RAT MT 6R S4CTATAMU Y EDC 8OS 92OQ IR 2UWAU P8 OZFFK YT OQ 7ZDDMOVU 1MMTIQ S7ZBIF
K L OX 3MOWMTOZBOV 91ECT 4GP7ZNMH ILOU UWT IP6WH EFGVOXUWA 2 3H93MU 1AH 6Y 2 2UYTEJXUWH VU Q U JXIK 4FGV EC J GR
ECT S6XUXIGV 1MT S3NNOQ IK Q94DMU R EC YS7 J WTU K YS5K 5L2IK 4FK 6V O 6V 6WHAH U 2UZFL IK VOXIFFK 7ZBUXIK 6XOQ
IL2IGVOZCTANMS8 S OZC 5Q TOXU P4FFFK O 3H8 OVU J R S6V 4DBAUXOP7ZCH8O 6XUZBENMHATABIDDM 6YH 95Q94BAS5JZBETABA RI
LOH UZCS5JXIGQ AM 93NMTU RANT TOVS7 OXORIR ET H MH 2 5K ZFGQ H H A 7 RECS6RIP8 IQ 7 WMMS 8 4BU P6WNOVOY S7 R ORI
K 4C 2 V OP6V 2UZNNECH NA 1NOP7 5Q95Q S94GWH OL2UWMS8 3NS8 1EMOZDNMH AUWTOWNNEBAH 94FG0 AH94GR IDDDDBIJ XEBAUZC
1TU O 6YS4GVU 7 Q92UXUWMTEJZFK 8 6WNEC 1ENS S7 V 6Y 1TEGR A YTEC UX 1A O 2IFJYT S 6YH OYT NEBIK AU GWAH 8 OZNM 2
6VOYMIL ABEM 5K 7 VOVU ZDMU EJ L2OP6XOVU ECT T 1NEBU GVOV 4BIFGP7 O 1MS NIGRAH8 7 L EGP8 EBOP5L2U J P6RIK IGREJ
Q AH AT HAH91MMS8OS8 EFJXEMU WH ETEFL2 1MH 6X S7 7 YT O 2UXIDCT 2OVU XUXUYH 6R Q MMHANMTIL1A 2ORIP4GP8OH AS7 6X
OL1MS7 YS3H EDDC 1NENS7 K 8 S5Q OYS4DCS7 L3T TEJ XOQ U OS7ZDBA AH OP4CT NOR O 4BA 3S5P4GRIQ OWTOYH EGWM 6RIRIP6X
5P4BOQ93H91AH8 5K U 3T Q 8 8 2 XOV 5P5K 3TEDCT OVOZFL1NIK 91TU YH92IJ Q 6VS8 94CH 8 6V IK U 3TAM 3M 4BUWAH IP7
93S5K MS7 P5K 5L1NNNA IK 3S7 XUZDNH ENNAS7 Q 1ECS5P8OU AMOWH S3H8 92OV 3MU GP5LOS7 WHAM 5P7 JZDBUXU K YM 6WMT 1T
U GV 7 JXU GQ92 ABOP7 V 5K 1AUYT TOZDCH92UZCT ECS3NS S5L2 2IJXEBIDBEMIQ 7 1EBEBIGR MS92 V 2 OH 1MS94DDNMMH U P8O
4FL3S6R ENS92OL2 U RIQ 93T OLO 3MIP7ZFJ WNIFGREFLOS 1T 1ENTU 4BOL IP4DNH OZNH EJYS7 ZDBIGP4CS4FFJ GWMMTU 1NIGWT
U 2IK K 95J GP7 Q ECH AT 6VU 3H S91TIP5P4DC 7 H 4FJ REJZNNNOVS93M 6REC 2IGQ 6X R NOP5Q EGRAMIK 6XENM 6WAS6XIFJ K
IGP8 4GWMH S7ZDMIQ 3S6Y U JYM S93S3H 7 YH 8 ILO 5L3H XECTEFJ P8 3S3MU K OS ATEDNNIFK 2UWH S8 OH IJ LO IP8 8O 2
IK 2 91AUWNET UXEBUWTEDDNHANH 5JYH94BIJX IQ EDBOQ 5Q OVS S 6XETAMIP5K XEMIL3H95P5P6WM 2OQ 91NIDDBUZDC EGRIL2 OU
OHABIGVS M 5L EDNS 6VOWA REFJZNS8 MH OV 1AS6VU VS8 OXEC 95L1AH ANS7 GR UWNOLOU XIFL2ORAMU GQ OV OU 2 1AS4CS6WA 4
DM 2 2 O 5Q OU L1TOWTEGWH NAH OXOQ91MH H IQ95L3M O OX XOL3S7 EFK MTECH 6WTIK 91M 3NH TU WMH M 3T ET AH EMOXUYMOY
MU P4GWA OS OR MTOV IDNS8O EM EFFFGR OVS95P7 ZBIJZFGVS91ETEJ V OHAH AUYS4BOVOWH TIL3MOYH 8 O ANS94BUYM OS8 7 P5P
8 6YM 4DCTECH8 3T S8 5P8 1TIR U LOS93T EGP6XECS7 WTIP7 XIJ VOZNNOV IRIK 5J K JY 1ET MS EJ J K 2IDNTIQ93MIRABORED
NTU ZDDBAH8OHAMU OV 2IJZNTIL IR NNAH92 1MTOXOL AMOY OS7 94FK 2 ANNETECTEJZCH U L OU ZBAS7ZBA 6VS 7 K OU VU 8 4DD
CH EFK 4CH IK 8 T 8 OS91NA WAUXEM 3H OWNENTEC O OU Q S EBEMU 92 7ZFFL3NTOYM 2 [...sequence repeats]

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 93S5K UE7 P5K A5L1 A ?K 3S7 XUZDNI EN AS7 Q =1ECS5P8O- .M/WI S3H8 92OVA3M- GP5L0E7 WI.MA5P7 JZDBUXU K YMA6WUO=1
O- GV= 7 JXU GQ92 .BOP7 V= 5K 1AUYT O/ZDCH92UZCT ECS3NE S5L2 2IJXEBIDBEM?0 = 7 1EBEBIGR UE92 VA2 OI 1UE94DDNUUI
- P8OA4FL3S6R ENE92OL2 - R?Q 93T OLOA3M?P7ZFJ W IFGR,FLOE =1O=1ENO- 4BOL ?P4DNI /ZNI ,JYS7 ZDBIGP4CS4FFJ GWUUO-
1 IGWO- 2IK K 95J GP7 Q ,CH .T A6V- 3H E91O?P5P4DC 7 I A4FJ R,JZN OVE93MA6R,C 2IGQ 6X R OP5Q ,GR.M?K 6XENUA6WAS6
XIFJ K IGP8 4GWUI S7ZDM?Q A3S6Y U JYM= E93S3H 7 YH 8 ?LOA5L3H XECT,FJ P8 3S3M- K OE .T,DN IFK 2UWI E8 OI IJ LO=
?P8 8OA2 IK 2 91AUW ET UXEBUWO,DDNI.NI 5JYH94BIJX ?Q ,DBOQ A5Q OVE E 6XET.M?P5K XEM?L3H95P5P6WUA20Q 91 IDDBUZDC
,GR?L2 O- OI.BIGVE UA5L ,DNE 6V/WA R,FJZNE8 UI OV=1AS6V- VE8 /XEC 95L1AH .NE7 GR UW OLO- XIFL2OR.M- GQ /V=O- 2 1
AS4CS6WA 4DMA2 2 OA5Q =O- L1O/WO,GWI = AH /XOQ91UI I ?Q95L3M=O= /X XOL3S7 ,FK UO,CH 6WO?K 91UA3NI O- WUI UA3T ET
 AH EM/XUYM/YM- P4GWA OE OR UO/V= IDNE8O= EM= ,FFFGR /VE95P7 ZBIJZFGVE91ET,J V=OI.H AUYS4BOV/WI O?L3M/YH 8 O= .N
E94BUYM=OE8 7 P5P8 6YMA4DCT,CH8 3T E8 5P8 1O?R U LOE93T = ,GP6XECS7 WO?P7 XIJ V/ZN OV= ?R?K 5J K JY 1ET UE ,J J
K 2IDNO?Q93M?R.BOR,DNO- ZDDBAH8OI.M- /VA2IJZNO?L ?R AH92 1UO/XOL .M/Y OE7 94FK 2 .N ET,CT,JZCH - L O- ZBAS7ZBA 6
VE 7 K O- V- 8 4DDCH ,FK 4CH ?K 8 O= 8 OE91 A WAUXEMA3H /W ENO,C O=O- Q E EBEM- 92 7ZFFL3NO/YMA2 Q ?K 1UA5Q92IFL
O=1A 2UY A5JZDMA4GVA5K 8 IK OI - 4DBOVE7 Y 1 EM/VA6R OP8 6YT ENO/V/WUE 6W OQ I .M= /W OQ95J X 8OI /V/YH8 .N AUX
ZFK ?P4BENI OQ .BIK 8 .T OI I.M?R IK ?Q O,GP4FJXOP5J P4C ZBUZBOQ = 6WO- K 5Q 1A L1EM=1 OL3N ENUUUA5JXUY O= 95JY
/WO=O=OA4DM?L1UO,FK P7 R 2 ?R.H .BU K 3N IDM= ZNUUA3S4GQ 92 7ZNI IDBOL3T,GVA3H 93NI S5J Q O= ,GWAUZNE 8 2OP4FL .
H95K ?L2UYH8 1 AS3T.H ?R,GV- VA4GQ - YM?R?R.M=1ET.H8 ,CS4C 4BET IFGW AS5L1O,DBEBA 1O= /YT.T AS5Q 95L /VE IDC WUA
4C O,DM/ZBECH94DBIDM/XIJXOR IGW IJYS5P6YS6YH8O- 4GR.N OL2IDCS3T IK ZNI.T IJYT 2OR AS3NO=OE 7 K 7 3NO,JX 93T.BUW
IGP6V- L3S4BEC /YS6WUI .T UZNO- P6YT.NI E 8O=OI UUA6YM- X WI /XENI =OI ,C 2OP8 .NO/XET A OA5J VE 94C OE95K 93S7Z
FL3T 2 = 8 8 6R,JXIDN A 8 8 ?K ZC 1O/Y 2U L2 ZCH 7 GWI.BUYH S3M?K 7ZC 2IFFGWO?R,DCS5L UYS6R.NE O- ?Q UZFJX X 7 W
AH8 OR.H 7 GVE7 GQ A3NUE 8 .H93H I - W A - WA UUUUI ECT I .NO,FGQ94GP5JYM/WAS4FJZC R.T.H 91EN IJ JYH O?Q E7 /ZCS
6YM?Q91A ,DM=1O?K .T,GQ ?P6R EM= 7 YM- 3M= I IFK .BAH - L3NE 6R,FFJYS3MA2OLOI A6XIJZCS3S4DNUA4FFL1EBOR UYT S4FL1
O= 95Q I.BAS3S6WI AUZFFGP5Q 7 A O- JZBOL1AU K I UXOR.BEBUY 2IK A 1EC O- 5LO= 8O- Q 7 P7 L1 ET A4CH8 =1 OR,GQ 8 ,
JYT,FFL /ZFJZDDDM= 5P6R.T UO= 6R S4CT.T.M- Y ,DC 8OE 92OQ ?R 2UWAU P8 /ZFFK YT OQ 7ZDDM/V- 1UUO?Q E7ZBIFK L /X 3
M/WUO/ZBOV= 91ECT 4GP7ZNUI ?LO- UWO= ?P6WI ,FGV/XUWA 2 3H93M- 1AH 6Y 2 2UYT,JXUWI V- Q - JXIK 4FGV= ,C J GR,CT S
6XUXIGV=1UO= S3N OQ IK Q94DM- R EC YS7 J WO- K YS5K 5L2IK 4FK 6V=OA6VA6WI.H - 2UZFL ?K V/XIFFK 7ZBUXIK 6XOQ ?L2I
GV/ZCT.NUE8 E /ZC 5Q O/XU P4FFFK OA3H8 /V- J R S6VA4DBAUXOP7ZCH8OA6XUZBENUI.T.BIDDMA6YH 95Q94BAS5JZBET.BA R?LOI
UZCS5JXIGQ .M= 93NUO- R.NO= O/VE7 /XOR?R ET I UI A2 5K ZFGQ I I A 7 R,CS6R?P8 ?Q 7 WUUE 8 4BU P6W OV/Y E7 R OR?K
 4C 2 V= OP6VA2UZN ECH A 1 OP7 5Q95Q E94GWI OL2UWUE8 3NE8 1EM/ZDNUI AUWO/W EBAH 94FGQ AH94GR IDDDDBIJ XEBAUZC 1O
- O= 6YS4GV- 7 Q92UXUWUO,JZFK 8 6W EC 1ENE S7 VA6Y 1O,GR A YT,C UX 1A OA2IFJYT E 6YH /YT EBIK AU GWAH 8 /ZNUA2 6
V/YM?L .BEMA5K 7 V/V- ZDM- ,J L2OP6XOV- ,CT O=1 EBU GV/VA4BIFGP7 O=1UE IGR.H8 7 L ,GP8 EBOP5L2U J P6R?K IGR,J Q
.H = .T I.H91UUE8OE8 ,FJXEM- WI ET,FL2 1UI 6X S7 7 YT =OA2UXIDCT A2OV- XUXUYH 6R Q UUI.NUO?L1A 2OR?P4GP8OI AS7 6
XOL1UE7 YS3H ,DDC 1 ENE7 K 8 S5Q /YS4DCS7 L3T O,J XOQ - OE7ZDBA .H OP4CT OR OA4BA 3S5P4GR?Q /WO/YH ,GWUA6R?R?P6X
 5P4BOQ93H91AH8 5K - 3T Q 8 8 2 XOVA5P5K 3T,DCT OV/ZFL1 IK 91O- YH92IJ Q 6VE8 94CH 8 6V= = ?K - A3T.MA3MA4BUWAH
?P7 [...sequence repeats]
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Seed: 8

S3S7 P8 7 8 /WI.N IDCH8 8 7 VE AS4GR S3T A3H A 0,JXET Y 20VE8 AS6YS3NUU0,GV/W A 0A6YT /XIK GQ 7 V- YT UI.H .H8 , C 6YM/X 0?K 0- L2IFK 7 X 2 J 0 ,DCH 7 Q ,CS7ZFFFFJZBAU J XIGWUO- 1O=0I 0R,C 1UI AH /XUX 4BIDNI I GV- K 6R A 0V- 4CS7 W 0P4GVE 6XUWO- V= /ZDBOP8 0Q920P7 JZNUE7 XEC Q A2IK /WUUI 20L3MA5J L .NI A 2 1 IFL1UUA4BEM/YT UY 1UA4GP8 0 - JXEC 2 ,JZDCT UUO=0- 7 ZCS5Q I EMA4CT E7 JYT.M/XEBET S3NE7ZCS4BAH950 80A5P8 5Q - = A4DBU L1A 7 P4DM/WO- 6WI UW UUA6R UI 0P80= /XUZFGP8 /Y 1AUXUXOQ S6W AH 7 5K 3M- V/YS3T,CT = 7 R UUE UYM- 0R?Q94FFGV- K ENUE A6R.H92OR,FGR EM ?P8 4BAUYH91O= IFJ VA5Q 6YT,GP7 YS6V= ,J WUO?R.T,CS3H92 20Q94C S3S3T UWI.T,JYH ?Q - Q I.NE 91UO?P6WAH I O/WAUY . T.NO?P4FGP6Y 2IDM- ZNE - 1 OQ /ZBAH I ,GQ E 0E80A3NE91UE8 ?P5L ?L ,JX Q93T UA6VE ?R.NUUE7 ET.NE8 .M- VA3NO?R AUX IFK 7 K R AH80- GR.T =1UUUE95L2 6R?Q I /Y ?L1 ECT.M= A 5L .T EBIFJXUXEN 0L 0- 1EC 0I EBUXECH /VA5JYT A 0I.NO- XO P8 2IFGQ /XIGP7 GR?K 6R.M/V/ZBU JZFJ L3H80E U0- J JZCS7 /WA /V= 6V- ,FFK 91ET = ,DM?R S7 K /YM/VE 91AS3H ?P6YM= ?L3T IDBA ZDCS4DM= 80- 0- K 1O,JYMA3T,FK 92IK 94BOR IFJZCT,GR,DDBEC 1UO- ZC 1O/ZN ENI .BECT AH 94GQ95P8 1O?Q 8 - 3T.T,FGWI UE8 8 ,DBAS4BIK Y ?L S4GWO/ZCH UWAS7 YT.H94CS5L3NUI U K R UZDBENE 7ZCT O,C 6R IFL3H 8 ?R 0VA6XEBOL0E8 ?R?Q OQ 6WI A3M= .M?Q 6WAU GP4DBET O?R?L1ENUO= 95P4FK ZDNO/X 8 A6WO= 7ZBEM=0A3T I = /VE7ZNO/WI - X P6XU JX 4FFK 5K 6WUI.BOQ ,JZBUWUA3H94FJYH8 .H 6Y 8 U P5L3T.N AU L3M?Q .T.T /YH - ZFFJXIFGVA4CS3M/V=1O= 5JZC 7 .MA4FK 2 W AS4 DBIK E 7 6Y O- R 1 A A2U GWI .M- Q95K ECS6X YM=1AUZDM/YS5L1ECH 92 0=1O/V- R,GR WO,FL /V/V= .H80=1EM- 2 4C 80E7 0 92UYH - 8 93H .M?LO=0E92UW AUYM?R UA4DNE7 4GQ 3NI - ?K 8 1A 7 ?P7 P6VE7 Q 7 L2UXOL2OL1ET,C V= 6YS7 2 0E 7ZFK =0 E7 LOA4DDDCS6VE92 .T IJZBIDC - P4BA O= 50 7 XOR,JY 2 8 3M?L2OQ O=0A5K ,JXOLO= I ET.T E 0L ,FGP4GQ O?P8 I.T O- 3S 6XEM= ?P8OE94CT U GR A 3T AUZBA 2IK Y 0A3S3NI.BEN EBOV- P7 94BEBENO/ZFK 3H ?L3S5JYS4FK 1 IFFJ Q = 5L1UA2 /ZBIK 3 MA3S7 Q /V- 2UYMA5L2OV= UI ,DNUO/WUA5K P4GP4BIGQ91EMA6V=1 IJ R IJ WI ENO=1A 1UUI O,FFGQ 94DNO,GQ93NE E8 0I O= - WA XU L ?Q92 K 4GV=0=1 AH8 7 J L1UI /WI IDDM?K 20L /WAH93NO- .H /ZDM=O- WO/XOVE 8 .BIFL ,C .NUI E7 ZNO= 910,FJY 0V- L2 S6YT I 0P7 K 2 2 YH8 6VA5L0A2 YH .BAUWUI = 92 20Q E 95K XUW IDNUE93T,J K 6YH95JZNI A5P6V= 8 5L3S7ZNE93H8 4CT,DBUYT.BET,GW IJXIJYH 80I 1ENI.H 6V- W EM- LO- YM?K K .BUXOV=0E .B0VA2 O=0= ,FL3M- 4DN ET AS6WO/VA3S5Q95JXENO ?K ZFL0A6W IK ?R,CH /WUI IK 7 ZFJYM?P4C ?Q ?K 6R.BAH8 0A4C XIK O/YT,DMA5Q .NUA3M/X0Q O- R?P5Q93S4C 1A ,CH91 0L3S 3S5LO- P5Q A4GR,GWO,J P7ZDC R.M- 4FJ J V- 0A20P5P7 R.H .MA2 6WUE7ZFGWA ,GVE8 4FL2IJ GQ ,FJZFL2UZBUYS7ZC ZB0R.T O R OQ =1O,CS5K YM/ZFGR?P7 ZN IK 5P7ZBOP6WUUUO/YS7 R?K O= ENI UO?K 4BUWI ?P5JX ZCT 1EM?R,J GVA2OR 95P6XIK 1ET 0P5K 8 =0= 7 0L1 AUWA 92U K 80= 94GV/YT A5K 2U P7 WO= .BA ,GV= .NI ?R IDM?P6V/VE80I E I S4BUZFK WI I E93N IGV- 20V/X EM/W IGQ EC 5JXOQ 6R?L3NI IGVA6V/ZDDC 3S4FGR.MA6XOR S5K 8 1UE 93H 6XIDBUWAUWI A Q A6YS5Q EC ECH8 ?K E95Q ?0 8 91 A WUE91A VE7 7 GP8 95K 4DCH ,CT.B0L2 R,DBIGWAS5P5Q - K ZBEB0Q 8 3H8 UUA2IGR 0L3H - VE94FL0- 3NUA5P4CH93T S7 L0I 0L10?L0E 8 7ZDNE95J Q91 EM?K S4DDBOR?L /YM= 8 UZBIGR?R,FK ,DDM- JYS6XOP6R,DM- 0I .H 8 5J R?R 7 XIDDCT.H UE 7 V= 1EBIJYM- XENE8 6XUYS5J JXOV/ZNE7 V- GWO=1UI.M=0I =1AH ET EM- P8 ,GQ E80- YS4CH A4B0P4DDMA2IDBIFFFL0I.T S5P7 0I S 6R,GP5P5L1 0VA4FGWUE = /YH93S6V/X XET E92IDDN 0P6YH IFFL2 10- 3H 8 IJZDN EMA2UWO?L2 2IJY 0I - GP6WO,CT IK 93M=1U A6X OE 6VA3T 94DC 2UX V/WO?Q ?L10- Q 0V/V/XOP4BUX 6WA 1AH91EBUZNUO,DC 0A4GW EBECS4GP6R UXUZC O- 0A6R?K YH 7ZN AH ,FL1AS7 GW OR EBA 1 EN OR.NI.M/ZNO,DNI 0= 5Q910/XIDMA3N A 2UZDDNE IJXUZNI UYH 93M/ZC 2IGP5K E8 92IGWI.H8 2UXET, DDDNO= ?Q A2 1EBAS6R ,FJ XUYT IGQ = UXIJ K 5P5JZFFL 0Q .H ,J R.BIJ P5J WAS3M= 6XIGR.BUZCH95L0I ?K 1AS5K 0E8 2 UA 2UY[...sequence repeats]

Seed: 9

H8 4CT,DBUYT.BET,GW IJXIJYH 80I 1ENI.H 6V- W EM- LO- YM?K K .BUXOV=0E .BOVA2 0=0= ,FL3M- 4DN ET AS6WO/VA3S5Q95JX
ENO?K ZFLOA6W IK ?R,CH /WUI IK 7 ZFJYM?P4C ?Q ?K 6R.BAH8 0A4C XIK O/YT,DMA5Q .NUA3M/XOQ O- R?P5Q93S4C 1A ,CH91 O
L3S3S5LO- P5Q A4GR,GWO,J P7ZDC R.M- 4FJ J V- 0A2OP5P7 R.H .MA2 6WUE7ZFGWA ,GVE8 4FL2IJ GQ ,FJZFL2UZBUYS7ZC ZBOR.
T OR OQ =1O,CS5K YM/ZFGR?P7 ZN IK 5P7ZBOP6WUUUO/YS7 R?K 0= ENI UO?K 4BUWI ?P5JX ZCT 1EM?R,J GVA2OR 95P6XIK 1ET O
P5K 8 =0= 7 OL1 AUWA 92U K 80= 94GV/YT A5K 2U P7 WO= .BA ,GV= .NI ?R IDM?P6V/VE8OI E I S4BUZFK WI I E93N IGV- 20
V/XEM/W IGQ EC 5JXOQ 6R?L3NI IGVA6V/ZDDC 3S4FGR.MA6XOR S5k 8 1UE 93H 6XIDBUWAUWI A Q A6YS5Q EC ECH8 ?K E95Q ?Q 8
91 A WUE91A VE7 7 GP8 95K 4DCH ,CT.BOL2 R,DBIGWAS5P5Q - K ZBEBOQ 8 3H8 UUA2IGR OL3H - VE94FLO- 3NUA5P4CH93T S7
LOI OL1O?LOE 8 7ZDNE95J Q91 EM?K S4DDBOR?L /YM= 8 UZBIGR?R,FK ,DDM- JYS6XOP6R,DM- OI .H 8 5J R?R 7 XIDDCT.H UE 7
V=1EBIJYM- XENE8 6XUYS5J JXOV/ZNE7 V- GWO=1UI.M=0I =1AH ET EM- P8 ,GQ E8O- YS4CH A4BOP4DDMA2IDBIFFFLQI.T S5P7 O
I S6R,GP5P5L1 OVA4FGWUE = /YH93S6V/X XET E92IDDN OP6YH IFFL2 1O- 3H 8 IJZDN EMA2UWO?L2 2IJY OI - GP6WO,CT IK 93M
=1UA6X OE 6VA3T 94DC 2UX V/WO?Q ?L1O- Q OV/V/XOP4BUX 6WA 1AH91EBUZNUO,DC 0A4GW EBECS4GP6R UXUZC O- OA6R?K YH 7ZN
AH ,FL1AS7 GW OR EBA 1 EN OR.NI.M/ZNO,DNI 0= 5Q91O/XIDMA3N A 2UZDDNE IJXUZNI UYH 93M/ZC 2IGP5K E8 92IGWI.H8 2UX
ET,DDDNO= ?Q A2 1EBAS6R ,FJ XUYT IGQ = UXIJ K 5P5JZFFL OQ .H ,J R.BIJ P5J WAS3M= 6XIGR.BUZCH95LOI ?K 1AS5K OE8 2
UA2UYS3S7 P8 7 8 /WI.N IDCH8 8 7 VE AS4GR S3T A3H A O,JXET Y 2OVE8 AS6YS3NUUO,GV/W A OA6YT /XIK GQ 7 V- YT UI.H
.H8 ,C 6YM/X O?K O- L2IFK 7 X 2 J Q ,DCH 7 Q ,CS7ZFFFFJZBAU J XIGWUO- 1O=OI OR,C 1UI AH /XUX 4BIDNI I GV- K 6R
A OV- 4CS7 W OP4GVE 6XUWO- V= /ZDBOP8 0Q92OP7 JZNUE7 XEC Q A2IK /WUUI 2OL3MA5J L .NI A 2 1 IFL1UUA4BEM/YT UY 1UA
4GP8 O- JXEC 2 ,JZDCT UUO=O- 7 ZCS5Q I EMA4CT E7 JYT.M/XEBET S3NE7ZCS4BAH95Q 8OA5P8 5Q - = A4DBU L1A 7 P4DM/WO-
6WI UWUUA6R UI OP8O= /XUZFGP8 /Y 1AUXUXOQ S6W AH 7 5K 3M- V/YS3T,CT = 7 R UUE UYM- OR?Q94FFGV- K ENUE A6R.H92OR,
FGR EM?P8 4BAUYH91O= IFJ VA5Q 6YT,GP7 YS6V= ,J WUO?R.T,CS3H92 2OQ94C S3S3T UWI.T,JYH ?Q - Q I.NE 91UO?P6WAH I O/
WAUY .T.NO?P4FGP6Y 2IDM- ZNE - 1 OQ /ZBAH I ,GQ E 0E8OA3NE91UE8 ?P5L ?L ,JX Q93T UA6VE ?R.NUUE7 ET.NE8 .M- VA3NO
?R AUXIFK 7 K R AH8O- GR.T =1UUUE95L2 6R?Q I /Y ?L1 ECT.M= A 5L .T EBIFJXUXEN OL O- 1EC OI EBUXECH /VA5JYT A OI.
NO- XOP8 2IFGQ /XIGP7 GR?K 6R.M/V/ZBU JZFJ L3H8OE UO- J JZCS7 /WA /V= 6V- ,FFK 91ET = ,DM?R S7 K /YM/VE 91AS3H ?
P6YM= ?L3T IDBA ZDCS4DM= 8O- O- K 1O,JYMA3T,FK 92IK 94BOR IFJZCT,GR,DDBEC 1UO- ZC 1O/ZN ENI .BECT AH 94GQ95P8 1O
?Q 8 - 3T.T,FGWI UE8 8 ,DBAS4BIK Y ?L S4GWO/ZCH UWAS7 YT.H94CS5L3NUI U K R UZDBENE 7ZCT O,C 6R IFL3H 8 ?R OVA6XE
BOLOE8 ?R?Q OQ 6WI A3M= .M?Q 6WAU GP4DBET O?R?L1ENUO= 95P4FK ZDNO/X 8 A6WO= 7ZBEM=0A3T I = /VE7ZNO/WI - X P6XU J
X 4FFK 5K 6WUI.BOQ ,JZBUWUA3H94FJYH8 .H 6Y 8 U P5L3T.N AU L3M?Q .T.T /YH - ZFFJXIFGVA4CS3M/V=1O= 5JZC 7 .MA4FK 2
W AS4DBIK E 7 6Y O- R 1 A A2U GWI .M- Q95K ECS6X YM=1AUZDM/YS5L1ECH 92 O=1O/V- R,GR WO,FL /V/V= .H8O=1EM- 2 4C
8OE7 Q 92UYH - 8 93H .M?LO=OE92UW AUYM?R UA4DNE7 4GQ 3NI - ?K 8 1A 7 ?P7 P6VE7 Q 7 L2UXOL2OL1ET,C V= 6YS7 2 OE 7
ZFK =OE7 LOA4DDDCS6VE92 .T IJZBIDC - P4BA O= 5Q 7 XOR,JY 2 8 3M?L2OQ O=OA5K ,JXOLO= I ET.T E OL ,FGP4GQ O?P8 I.T
O- 3S6XEM= ?P8OE94CT U GR A 3T AUZBA 2IK Y OA3S3NI.BEN EBOV- P7 94BEBENO/ZFK 3H ?L3S5JYS4FK 1 IFFJ Q = 5L1UA2 /
ZBIK 3MA3S7 Q /V- 2UYMA5L2OV= UI ,DNUO/WUA5K P4GP4BIGQ91EMA6V=1 IJ R IJ WI ENO=1A 1UUI O,FFGQ 94DNO,GQ93NE E8 OI
O= - WA XU L ?Q92 K 4GV=O=1 AH8 7 J L1UI /WI IDDM?K 2OL /WAH93NO- .H /ZDM=O- WO/XOVE 8 .BIFL ,C .NUI E7 ZNO= 91
O,FJY OV- L2 S6YT I OP7 K 2 2 YH8 6VA5LOA2 YH .BAUWUI = 92 2OQ E 95K XUW IDNUE93T,J K 6YH95JZNI A5P6V= 8 5L3S7ZN
E93[...sequence repeats]

Seed: 0

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!!!!EN' .BECT AH 94G095P8 1"?Q 8 - 3T.T,FGW' (;8 8' ,DBAS4BIK Y ?L S4GW"/ZCH UWAS7 YT.H94CS5L3N(' U K R UZDBEN; 7
ZCT ",C 6R IFL3H 8 ?R OV:6XEBOLO;8 ?R?Q !OO 6W' :3M= .M?Q 6WAU GP4DBET "?R?L1EN("= 95P4FK ZDN"/X 8 :6W"= 7ZBEM=O
:3T ' = /V;7ZN"/W' - X P6XU JX 4FFK 5K 6W(' .BOQ ,JZBUW(:3H94FJYH8 .H 6Y 8 U P5L3T.N!AU L3M?Q .T.T /YH - ZFFJXIFG
V:4CS3M/V=1"= 5JZC 7 .M:4FK 2 W'!AS4DBIK ; 7 6Y O- R 1'A :2U GW' .M- Q95K 'ECS6X YM=1AUZDM/YS5L1ECH 92 O=1"/V- R
,GR W",FL /V/V= .H80=1EM- 2 4C 80;7 Q 92UYH - 8 93H .M?LO=0;92UW!AUYM?R (:4DN;7 4GQ 3N' - ?K 8 1A 7 ?P7 P6V;7 Q
7 L2UXOL2OL1ET,C V= 6YS7 2 O; 7ZFK =0;7 LO:4DDDCS6V;92 .T !IJZBIDC - P4BA O= 5Q 7 XOR,JY 2 8 3M?L2OO "=O:5K ,JXO
LO= ' 'ET.T ; OL ,FGP4GQ "?P8 '.T "- 3S6XEM= ?P8O;94CT U GR !A 3T AUZBA 2IK Y O:3S3N'.BEN'EBOV- P7 94BEBEN"/ZFK
3H ?L3S5JYS4FK 1!'IFFJ 0 = 5L1(:2 /ZBIK 3M:3S7 0 /V- 2UYM:5L2OV= (' ,DN("/W(:5K P4GP4BIG091EM:6V=1'IJ R IJ W' !E
N"=1A 1((' ",FFGQ 94DN",G093N; ;8 O' "= - WA XU L ?092 K 4GV=O=1!AH8 7 J L1(' /W' IDDM?K 2OL /WAH93N"- .H /ZDM=O
- W"/XOV; 8 .BIFL ,C .N(' ;7 ZN"= 91",FJY !OV- L2 S6YT ' OP7 K 2 2 YH8 6V:5LO:2 YH .BAUW(' = 92 2OO ; 95K XUW'ID
N(;93T,J K 6YH95JZN' :5P6V= 8 5L3S7ZN;93H8 4CT,DBUYT.BET,GW!!IJXIJYH 8O' 1EN'.H 6V- W!EM- LO- YM?K K .BUXOV=0; .
BOV:2 O=0= ,FL3M- 4DN!!ET !AS6W"/V:3S5Q95JXEN"?K ZFLO:6W'IK ?R,CH /W(' IK 7 ZFJYM?P4C ?Q ?K 6R.BAH8 O:4C XIK "/Y
T,DM:5Q .N(:3M/XOQ "- R?P5Q93S4C 1A ,CH91!OL3S3S5LO- P5Q :4GR,GW",J P7ZDC R.M- 4FJ J V- O:2OP5P7 R.H .M:2 6W(;7Z
FGWA ,GV;8 4FL2IJ GQ ,FJZFL2UZBUYS7ZC ZBOR.T OR OQ =1",CS5K YM/ZFGR?P7 ZN'IK 5P7ZBOP6W(((''/YS7 R?K O= EN' ("?K 4
BUW' ?P5JX ZCT 1EM?R,J GV:2OR 95P6XIK 1ET OP5K 8 =0= 7 OL1!AUWA 92U K 8O= 94GV/YT :5K 2U P7 W"= .BA ,GV= .N' ?R
IDM?P6V/V;8O' ; ' S4BUZFK W' ' ;93N!IGV- 2OV/XEM/W'IQO '!EC 5JXOQ 6R?L3N' IGV:6V/ZDDC 3S4FGR.M:6XOR S5P 8 1(: 93
H 6XIDBUWAUW' A Q :6YS5Q EC ECH8 ?K ;95Q ?Q 8 91!!A W(;91A V;7 7 GP8 95K 4DCH ,CT.BOL2 R,DBIGWAS5P5Q - K ZBEBOQ
8 3H8 ((:2IGR OL3H - V;94FLO- 3N(:5P4CH93T S7 LO' !OL1"?LO; 8 7ZDN;95J Q91!EM?K S4DDBOR?L /YM= 8 UZBIGR?R,FK ,DD
M- JYS6XOP6R,DM- O' .H 8 5J R?R 7 XIDDCT.H (; 7 V=1EBIJYM- XEN;8 6XUYS5J JXOV/ZN;7 V- GW"=1(' .M=O' =1AH ET EM- P
8 ,GQ ;8O- YS4CH :4BOP4DDM:2IDBIFFFLO'.T S5P7 O' S6R,GP5P5L1!OV:4FGW(; = /YH93S6V/X XET ;92IDDN!OP6YH IFFL2 1"-
3H 8 IJZDN!EM:2UW"?L2 2IJY O' - GP6W",CT IK 93M=1(:6X O; 6V:3T 94DC 2UX V/W"?Q ?L1"- Q OV/V/XOP4BUX 6WA 1AH91EBU
ZN(",DC O:4GW!EBECS4GP6R UXUZC O- O:6R?K YH 7ZN!AH ,FL1AS7 GW!OR EBA 1!EN!OR.N'.M/ZN",DN' O= 5Q91"/X1DM:3N!A 2UZ
DDN; IJXUZN' UYH 93M/ZC 2IGP5K ;8 92IGW'.H8 2UXET,DDDN"= ?Q :2 1EBAS6R ,FJ XUYT IQQ = UXIJ K 5P5JZFFL OQ .H ,J R
.BIJ P5J WAS3M= 6XIGR.BUZCH95LO' ?K 1AS5K O;8 2 (:2UYS3S7 P8 7 8 /W'.N!IDCH8 8 7 V; AS4GR S3T :3H A ",JXET Y 2OV
;8 AS6YS3N(",GV/W!A O:6YT /XIK GQ 7 V- YT ('.H .H8 ,C 6YM/X "?K "- L2IFK 7 X 2 J Q ,DCH 7 Q ,CS7ZFFFFJZBAU J XI
GW("- 1"=O' OR,C 1(' AH /XUX 4BIDN' ' GV- K 6R A OV- 4CS7 W!OP4GV; 6XUW"- V= /ZDBOP8 OQ92OP7 JZN(;7 XEC Q :2IK /
W((' 2OL3M:5J L .N' A 2 1!IFL1(((:4BEM/YT UY 1(:4GP8 O- JXEC 2 ,JZDCT (("=O- 7 ZCS5Q ' EM:4CT ;7 JYT.M/XEBET 83N;
7ZCS4BAH95Q 80:5P8 5Q - = :4DBU L1A 7 P4DM/W"- 6W' UW((:6R (' !!'OP8O= /XUZFGP8 /Y 1AUXUXOQ S6W!AH 7 5K 3M- V/YS
3T,CT = 7 R ((; UYM- !!OR?Q94FFGV- K EN(; :6R.H92OR,FGR EM?P8 4BAUYH91"= IFJ V:5Q 6YT,GP7 YS6V= ,J W("?R.T,CS3H9
2 2OQ94C S3S3T UW'.T,JYH ?Q - Q '.N; 91("?P6WAH ' "/WAUY .T.N"?P4FGP6Y 2IDM- ZN; - 1!OQ /ZBAH ' ,GO ; O;8O:3N;91
(;8 ?P5L ?L ,JX Q93T (:6V; ?R.N((;7 ET.N;8 .M- V:3N"?R AUXIFK 7 K R AH8O- GR.T =1(((;95L2 6R?Q ' /Y ?L1!ECT.M= A
 5L .T EBIFJXUXEN!!OL O- 1EC O' EBUXECH /V:5JYT A O'.N"- XOP8 2IFGQ /XIGP7 GR?K 6R.M/V/ZBU JZFJ L3H8O; ("- J JZC
S7 /WA /V= 6V- ,FFK 91ET = ,DM?R S7 K /YM/V; 91AS3H ?P6YM= ?L3T IDBA ZDCS4DM= 8O- O- K 1",JYM:3T,FK 92IK 94BOR !
IFJZCT,GR,DDBEC 1("- ZC 1"/ZN[...sequence repeats]
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IN CASE OF DIFFICULTY

This part of the Manual will help you locate and correct any difficulty which might occur in your µMatic Memory Keyer. This information is divided into three sections. The first section, "General", contains suggestions in the following areas:

A. Visual checks and inspection.
B. Precautions to observe when bench testing.
C. How to determine the area of the µMatic Memory Keyer in which the difficulty is located ("How To Troubleshoot Your Keyer").
D. Locating and correcting both the cause and the effect of a difficulty ("Repairing the Keyer").

The second section consists of a "Troubleshooting Chart". This chart calls out specific problems that may occur and lists one or more conditions or components that could cause each difficulty. The resistor R numbers, capacitor C numbers, transistor Q numbers and diode D numbers are identified in this chart by the same number that are used on the Schematic Diagram. X-Ray Views are also provided to help you locate the component and test points.

GENERAL

PRECAUTIONS FOR BENCH TESTING

1. Be cautious when testing solid-state circuits. Although transistors and integrated circuits have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than other circuit components.

2. Be sure you do not short any terminals to ground when making voltage measurements. If the Probe slips, for example, and shorts out a bias or voltage supply, this could cause damage to one or more transistors or diodes.

3. Do not remove transistors or integrated circuits while the µMatic Memory Keyer is turned on, since this could damage the keyer.

HOW TO TROUBLESHOOT YOUR KEYER

If you know which area your trouble is in, apply the "Visual Checks" to that area.

You may also go directly to the Troubleshooting Charts to see if the difficulty you are having is listed in one of the "Problem" columns. If your difficulty is listed there, check the "Possible Causes" listed for this problem and apply the "Visual Check" listed to the area of difficulty.

REPAIRING THE KEYER

When you make repairs to your keyer, make sure you eliminate the cause as well as the effect of the difficulty. If, for example, you find a damaged resistor, be sure you find out what it was (wiring, error etc.) that caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may also become damaged when you put the keyer back into operation.

TROUBLESHOOTING CHART

This Troubleshooting Chart lists specific difficulties that could occur in your µMatic Memory Keyer. Several possible causes may be listed for each difficulty. Refer to the X-RAY View (page 30) of the circuit board and the Schematic Diagram to locate and identify the part listed in this chart.

If the particular part is mentioned (U1 for example) as a possible cause, check that part and other components connected to that part to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSES
Keyer inoperative	1. Socket S4 unplugged from U4
Steady sidetone; all LEDs lit	1. U1
Steady sidetone; no LEDs lit	1. U2 and/or U3 2. Low voltage
Auto shutoff occurs too soon	1. Capacitor C9 backwards or defective 2. IC U6
No sidetone	1. ICs U8, U9 2. Transistor Q13 3. Speaker miswired or open
Negative keylines will not key	1. Transistor Q16 2. No –3 volts: diode D2 and D3; capacitors C2 and C3; transistors Q17 and Q18
Random dots and dashes sent while transmitting	1. Paddle sensitivity set too high 2. RF at the station location*

* If stray RF is a problem at your station location, it may cause random dots and dashs while you are transmitting. To prevent this from happening, make sure that all of your equipment is grounded to common point. In extreme cases, it may be necessary to rest your hand on a metal plate positioned under the keyer. This plate should also be grounded at the same common point as the keyer.

SPECIFICATIONS

Speed Range ..... 1 to 99 WPM.

Spacing ..... Less than or equal to Speed.

Number of Buffers ..... 1 to 10. May be used to store text or commands strings.

Buffer Size ..... 240 characters and/or commands.

Weighting ..... Normal plus five "light" and five "heavy" settings.

Auto Message Repeat ..... 0 to 9 (Sent one to ten times).

Keyer Output ..... Solid state: +250 volts @ 100 mA; –200 volts @ 40 mA.

Power Source ..... External plugable transformer or 11 to 16 volt DC, 200 mA source.

Memory Backup ..... 3 miniature cells have a lifetime of 1 year (typical). (There is no battery drain unless the keyer is removed from the external power source.)

Paddles ..... Built-in (removable) capacitive "touch" type, with provision for external mechanical paddles.

Sidetone Pitch ..... Approximately 300 – 1500 Hz; adjustable.

Microprocessor ..... Custom 3870

Speed Algorithm ..... Words per minute (WPM) = 2.4 × dots per second.

LED Mode Indicators ..... Normal, Pause, Load, Send, Practice.

Practice Characters ..... A – Z, 0 – 9, Punct.: . , ? / — — — : ; ' " (!
Random length code groups of selectable types.

Operating Temp. Range ..... 32 – 104 °F (0 – 40 °C)

Dimensions (less paddles) .. 4-1/8" (W) × 6" (D) × 1-5/8" (H); (10.5 × 15.2 × 4.1 cm)

Weight ..... 1 lb. 14 oz. (.86 kg)

CIRCUIT DESCRIPTION

CONTROLLER

The SA-2010A Memory Keyer is controlled mainly by U1 which is a custom 3870 single-chip microprocessor. This microprocessor services the keypad and paddles, determines basic keyer timing, keys the sidetone and output circuitry, stores and retrieves data from the external RAM and updates the status LEDs.

The 3579.545 kHz crystal (Y1) determines the frequency of the clock and its output is divided internally to provide a 500 µs basic timing interval. This time interval forms the dots, dashes, interelement, intercharacter and interword spaces, which all depend on the speed, spacing and weight for which the Memory Keyer is set from the keypad.

Capacitor C1 and an internal pull-up resistor provide a power-on reset to the microprocessor. Diode D1 allows capacitor C1 to discharge quickly when the Memory Keyer is turned off.

Port 0 is an address bus for the external RAM, which consists of ICs U2 and U3. This RAM is a message buffer memory and also stores the last-set keyer parameters.

Port 4 is the data bus for the external RAM and for the LED latch IC U7. This port has a strobe pin that clocks data into either RAM or the latch, whichever is enabled, when data is output to this port.

Port 5 is a multipurpose output that selects either the RAM or the LED latch for a "write" operation or, enables RAM for a "read" operation (bits 6 and 7). It gates the sidetone to the speaker (bit 4) and determines whether the keyer output will be keyed output will be keyed with the sidetone (bit 5). It also lowers the sidetone pitch when necessary (bit 3) and scans the three keypad columns (bit 0, 1 and 2).

Port 1 inputs the key pattern from the selected column. Internal pull-ups cause all inputs to be held high until a key is pressed. When you press a key in the selected column, the low level on the column line is passed through the switch contacts to the associated bit in port 1. The key is recognized by U1 and the appropriate action taken. The dot/dash paddles are effectively part of the keypad matrix, but are handled differently by the microprocessor.

The TUNE key is not part of the keypad matrix. It is connected to the external interrupt pin on U1. This key is active only when the keyer is in "Normal" or "Paused" modes, and only when the keyer has completed the last character sent. The keyer is then latched in the Tune mode until you press some other key (or touch a paddle). At this time, the Tune mode is unlatched and that key performs its normal function.

SIDETONE OSCILLATOR / TOUCH PADDLE CIRCUITRY

OR gate IC U9D, inverter U8B and their associated components form an astable oscillator. This oscillator runs continuously while the keyer is turned on the oscillator frequency is manually adjusted with Pitch control R39. The output of this oscillator is gated through IC U9C by the microprocessor to transistor Q13 which drives speaker SP201.

The output of the oscillator, which is buffered by transistors Q17 and Q18, also drives the "D" input and clock input of flip-flop IC U11A and B. With paddle controls R12 and R13 properly set, the D input will go high just in time for the rising edge of the clock to SET the flip-flops. When you touch a paddle, your body capacitance is added to delay the D input enough that is still low when the clock goes high, resetting the associated flip-flop. This turns the transistors Q2 and Q3 on and acts

as a closed switch in the matrix. When you use external paddles, transistors Q4 or Q5 are turned off by a paddle closure, also resetting the associated flip-flop, producing the same results.

The oscillator also drives a "charge-pump". This circuit consists of capacitor C2 and C3 and diodes D2 and D3. These components provide a negative potential to the negative (–) keyer output circuitry.

OUTPUT CIRCUITRY

OR Gate IC U9B allows the microprocessor to determine whether the output on port 5, bit 4, will key the output circuitry and sidetone, or just the sidetone. If U9B is enabled, its output will go low on each dot and dash, turning off transistor Q12. This allows transistor Q14 to turn on through resistors R31 and R32, to key a positive keyline to ground. At the same time, the base of transistor Q15 goes to near zero volts, turning it off and allowing transistor Q16 to key a negative keyline to ground. Protective diodes across the two keyer output jacks prevent damage to to the output transistors if the wrong jack is selected for a particular transmitter. The transmitter would then be keyed continuously.

POWER SWITCHING CIRCUIT

The power switching circuitry allows the keyer to be turned on and off with a momentary switch. It also forces the keyer to be off whenever you plug it in and provides automatic turn-off after a period of nonuse. Transistor Q8 is a series pass transistor between the diode bridge and the major part of the circuitry. Note, that IC U6 is connected to the output of the bridge at all times. (It draws virtually no current itself.) U6B and U6D form an R-S flip-flop which drives ICs U6A and C in parallel to turn transistor Q8 on or off. When the keyer is plugged in, capacitor C9 will have discharged through diode D13, which holds the output of IC U6D high. Both inputs of U6B will therefore be high, making the output of IC U6B low and the output of U6A and C high. This keeps transistor Q8, and thus the keyer, turned off.

When you press the **ON** button, one input of IC U6B goes low and causes its output to go high. The output of IC U6A and C goes low. This turns transistor Q8 on and supplies power to the keyer. At the same time, transistor Q9 is turned on and charges capacitor C9. Both inputs of IC U6D are high and its low output holds the R-S flip-flop in the "on" state when the **ON** button is released. When you leave the keyer on for a period of time, but do not use it, capacitor C9 discharges far enough to take the input of IC U6D to a low state. The R-S flop-flop now toggles to turn the keyer off. Transistor Q11 is connected to effectively "push" the **ON** button whenever the sidetone sounds and resets the automatic shutoff interval.

MEMORY BACKUP CIRCUIT

ICs U2 and U3 are "256 × 4" CMOS RAMs connected as a 256 × 8 RAM. They have very low power consumption in the standby mode. This allows them to retain data with a supply voltage as low as 2 volts. This standby mode is selected by bringing chip-enable pin CE2 on ICs U2 and U3 low. To insure that data is not lost when the keyer is shut off or loses power, transistors Q6 and Q7 and their associated components sense drop in the supply voltage below the minimum required for ICs U4 and U5 to remain in regulation and pull CE2 low.

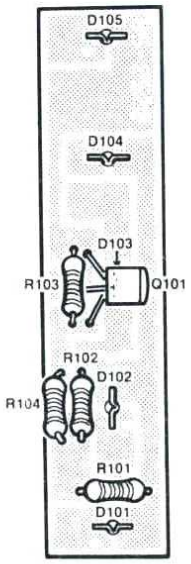
As the collector voltage of transistor Q8 falls, capacitor C7 discharges quickly through diode D7. When this voltage reaches approximately 8 volts, transistor Q6 and Q7 turn off, allowing CE2 to go low through resistor R21. As the output of IC U5 falls below the battery voltage, diode D4 becomes forward biased and diode D5 reverse biased. (Diode D6 makes up for the voltage drop across diode D5 when the keyer is on.) The RAM is now in the standby mode. The backup batter-

ies are only switched in when the keyer is disconnected from its source of power; thus, you can extend the battery life by leaving the keyer plugged into an AC outlet when it is not in use.

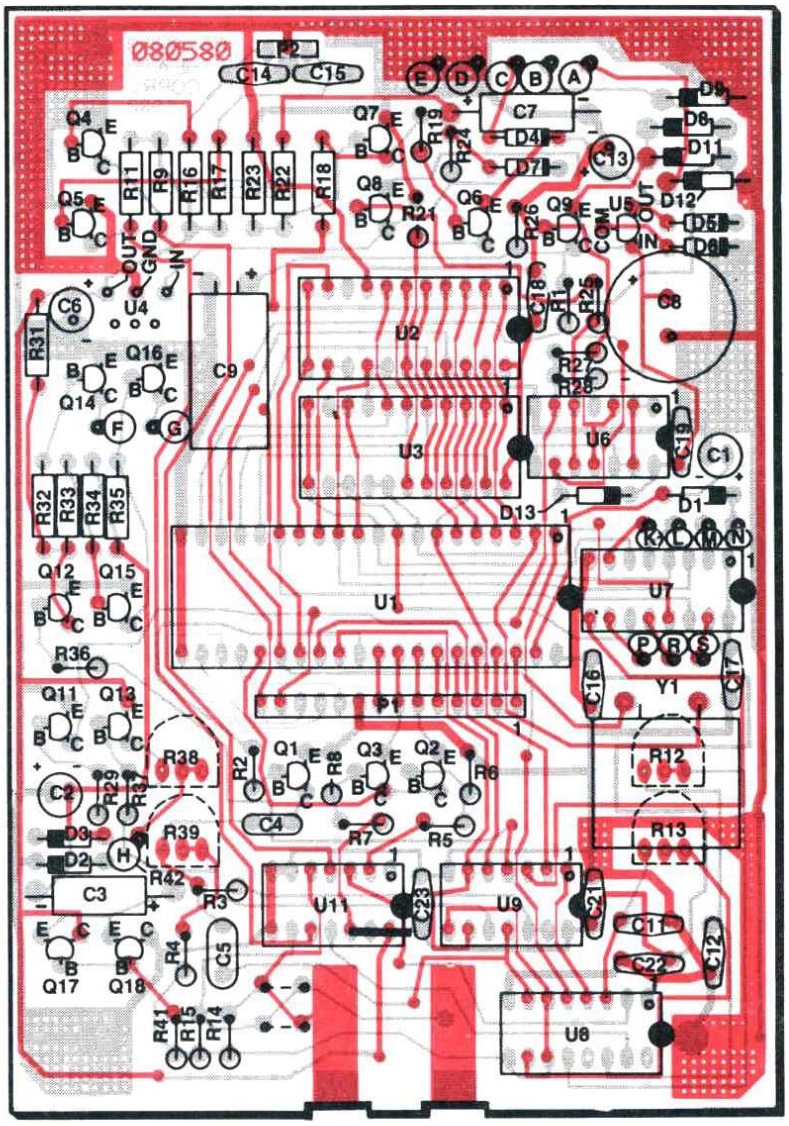
STATUS LEDs

Whenever the status of the keyer is changed, the data in an internal status register is atache into IC U7 and causes the appropriate LED(s) to light. One of the status bits go low when a digit key is pressed. This bit turns off transistor Q101 when the keyer is in the Normal mode and dims the NORM LED as a reminder that the keyer is expecting a function key to be pressed.

CIRCUIT BOARD X-RAY VIEWS

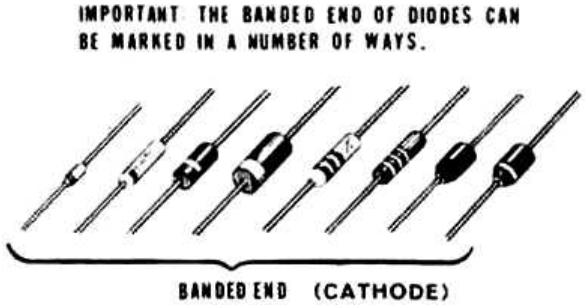
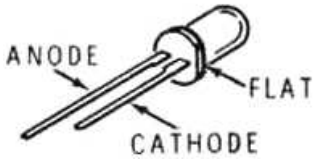


LED CIRCUIT BOARD



MAIN CIRCUIT BOARD

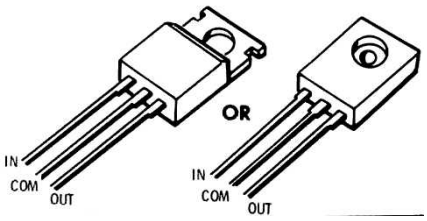
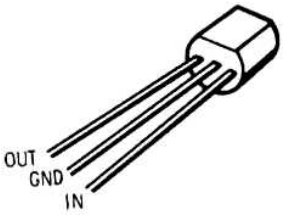
DIODES

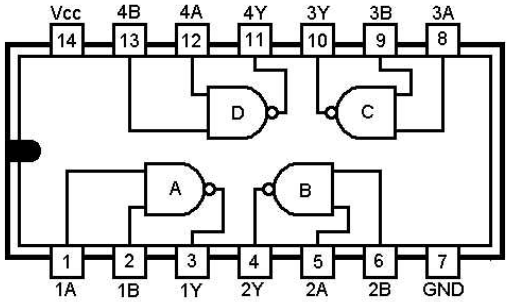
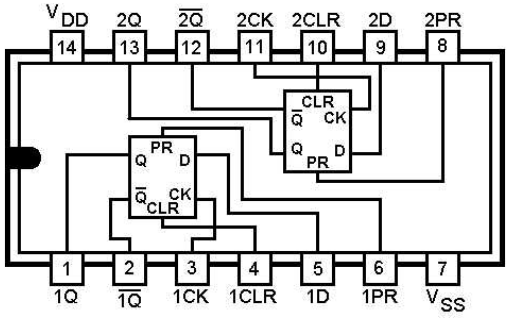
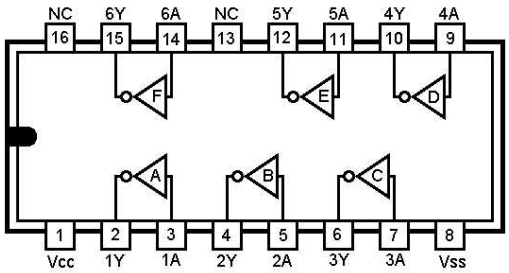
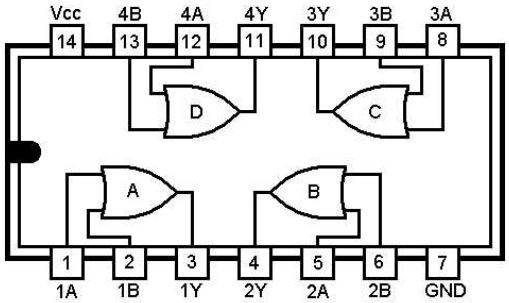
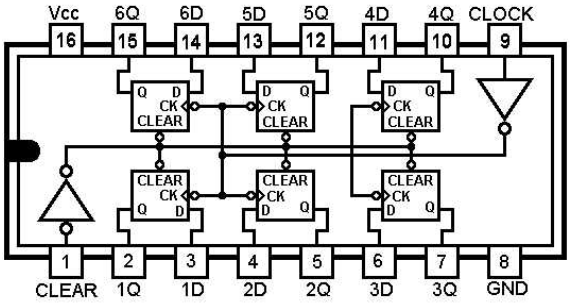
MAY BE REPLACED WITH	CIRCUIT COMP. NO.	IDENTIFICATION
1N4149	D1, D5, D6, D7, D13	
GD510	D2, D3, D4	
DRS110, 1N5399	D201, D202	
1N4002	D8, D9, D11, D12	
TIL209	D101...D105	

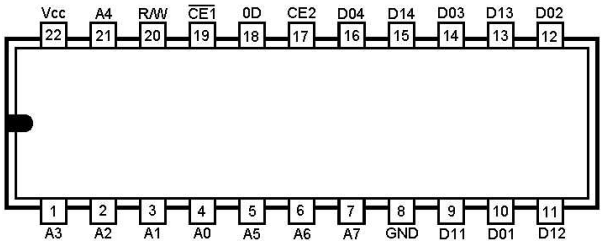
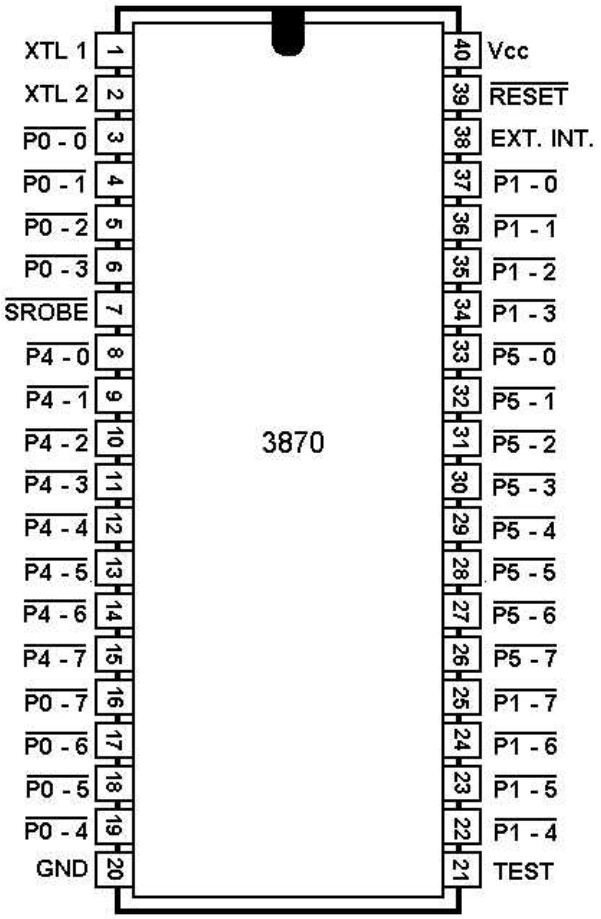
TRANSISTORS

MAY BE REPLACED WITH	CIRCUIT COMP. NO.	IDENTIFICATION
2N4121	Q6, Q15	
MPSA42	Q14	
MPSA20	Q1...Q5, Q7, Q11, Q12, Q101	
MPSA05	Q17	
MPSA55	Q8, Q9, Q13, Q18	
MPSA93	Q16	

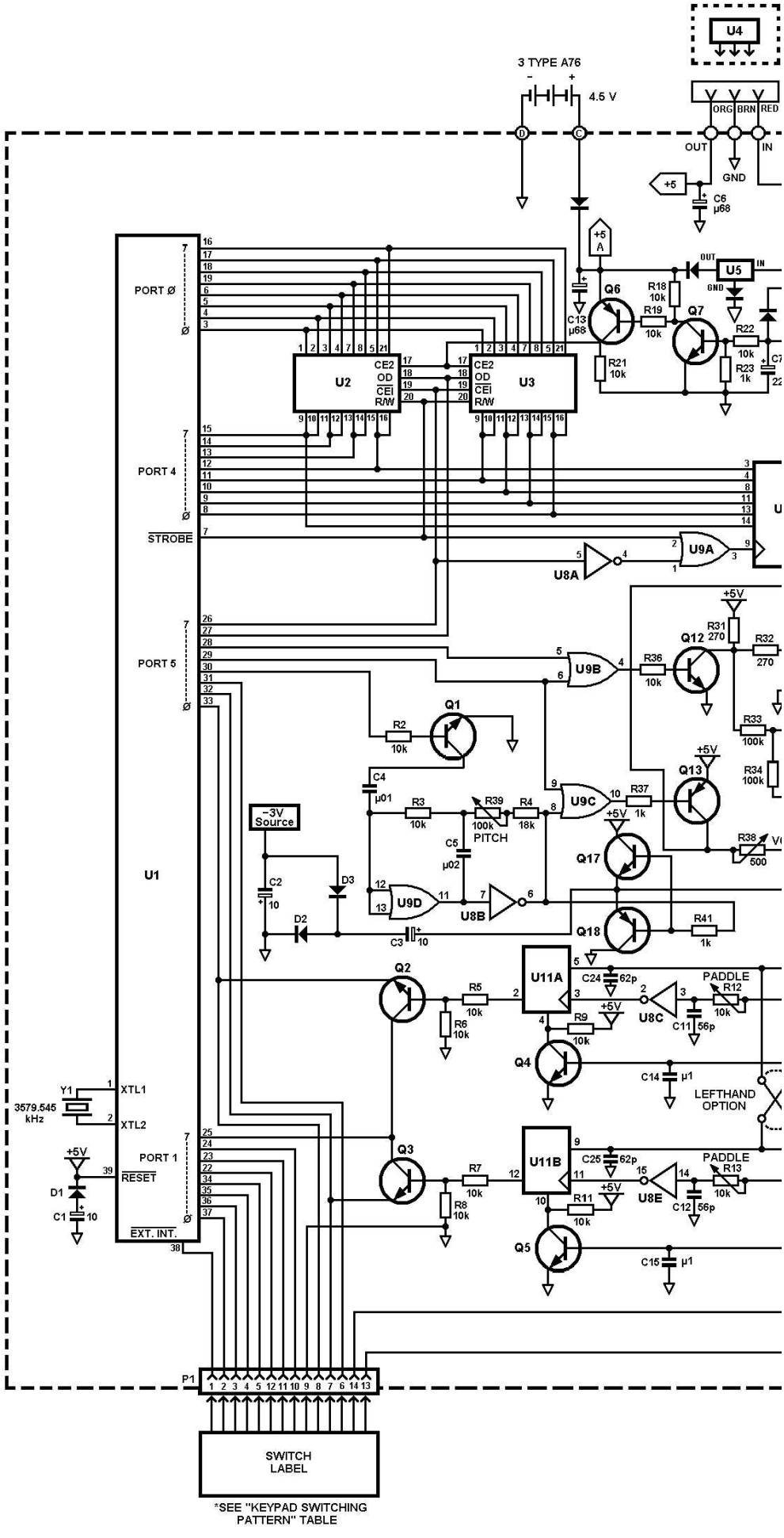
INTEGRATED CIRCUITS

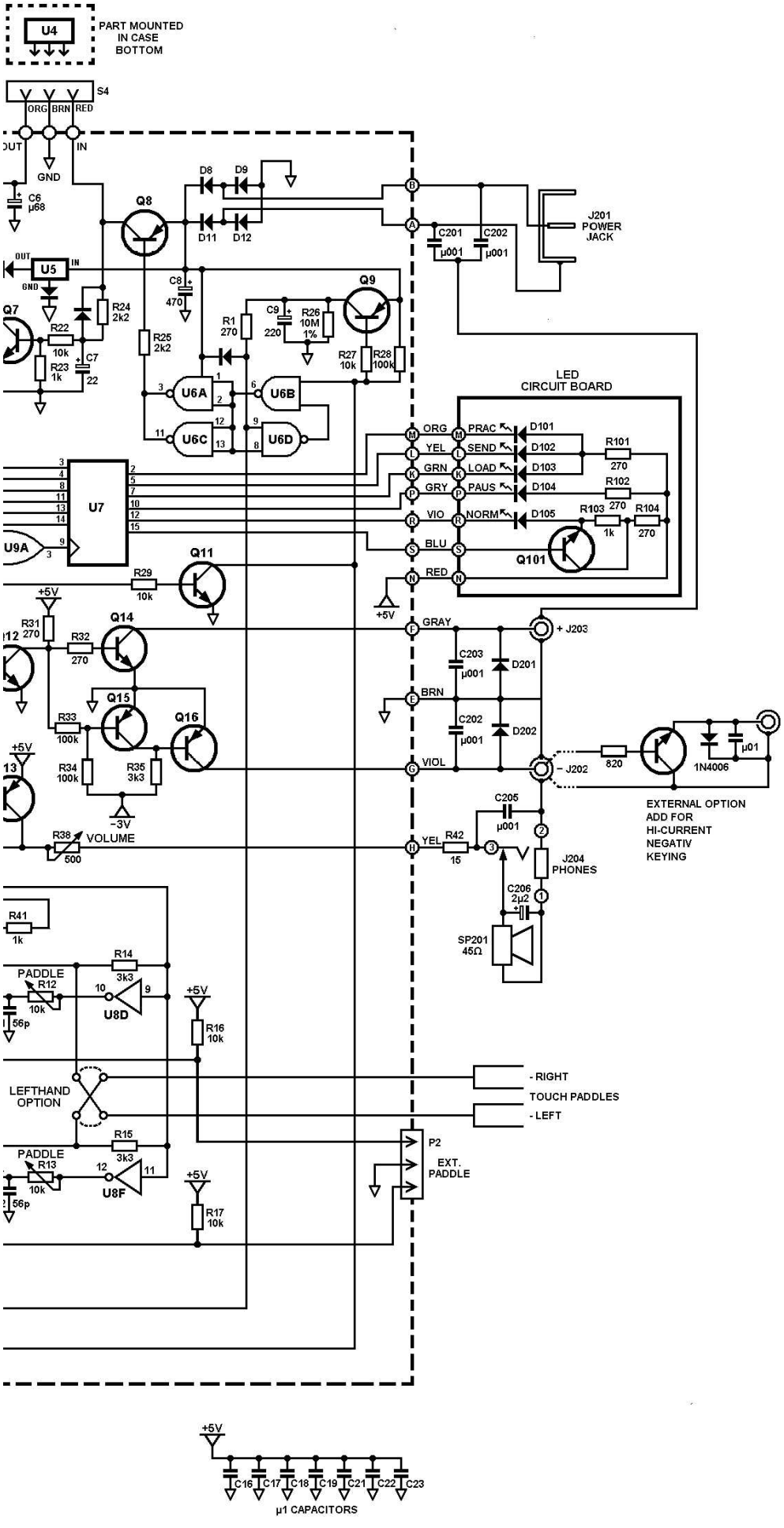
MAY BE REPLACED WITH	CIRCUIT COMP. NO.	IDENTIFICATION
7805	U4	
78L05	U5	

MAY BE REPLACED WITH	CIRCUIT COMP. NO.	IDENTIFICATION
CD4011	U6	
14013	U11	
14049	U8	
14071	U9	
74LS174	U7	

MAY BE REPLACED WITH	CIRCUIT COMP. NO.	IDENTIFICATION
5101 or 51L01	U2, U3	
3870	U1	

SCHEMATIC OF THE HEATHKIT® SA-5010 µMATIC KEYER


U4
3 TYPE A76
4.5 V
ORG
BRN
RED
OUT
IN
GND
+5
C6
µ68
U1
PORT Ø
PORT 4
STROBE
PORT 5
PORT 1
RESET
EXT. INT.
XTL1
XTL2
Y1
3579.545
kHz
U2
U3
CE2
OD
CEI
R/W
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q12
Q13
Q17
Q18
R2
R3
R4
R5
R6
R7
R8
R9
R11
R12
R13
R18
R19
R21
R22
R23
R31
R32
R33
R34
R36
R37
R38
R39
R41
10k
18k
1k
270
100k
500
PITCH
C1
C2
C3
C4
C5
C6
C7
C11
C12
C13
C14
C15
C24
C25
µ01
µ02
µ1
62p
56p
10
D1
D2
D3
-3V
Source
U8A
U8B
U8C
U8E
U9A
U9B
U9C
U9D
U11A
U11B
PADDLE
LEFTHAND
OPTION
P1
SWITCH
LABEL
*SEE "KEYPAD SWITCHING
PATTERN" TABLE


U4
PART MOUNTED IN CASE BOTTOM
S4
ORG BRN RED
OUT
IN
GND
C6 µ68
Q8
D8 D9
D11 D12
J201 POWER JACK
C201 µ001
C202 µ001
U5
C8 470
Q9
R1 270
C9 220
R26 10M 1%
R27 10k
R28 100k
Q7
R22 10k
R23 1k
C7 22
R24 2k2
R25 2k2
U6A
U6B
U6C
U6D
LED CIRCUIT BOARD
ORG
YEL
GRN
GRY
VIO
BLU
RED
PRAC
SEND
LOAD
PAUS
NORM
D101
D102
D103
D104
D105
R101 270
R102
R103 270
R104 270
1k
Q101
U7
U9A
Q11
R29 10k
+5V
R31 270
Q14
R32 270
GRAY
+ J203
C203 µ001
D201
BRN
C202 µ001
D202
Q15
Q16
R33 100k
R34 100k
R35 3k3
VIOL
- J202
820
1N4006
µ01
-3V
R38 VOLUME 500
EXTERNAL OPTION ADD FOR HI-CURRENT NEGATIV KEYING
C205 µ001
YEL
R42 15
J204 PHONES
C206 2µ2
SP201 45Ω
R41 1k
R14 3k3
PADDLE R12 10k
U8D
56p
R16 10k
- RIGHT
TOUCH PADDLES
- LEFT
LEFTHAND OPTION
R15 3k3
PADDLE R13 10k
U8F
P2
EXT. PADDLE
R17 10k
C16 C17 C18 C19 C21 C22 C23
µ1 CAPACITORS

NOTES:

1. Parts are numbered in the following groups:
   1 – 49 Parts on the main circuit board.
   100 – 109 Parts on the LED circuit board.
   200 – 209 Parts on the case.

2. All resistors are ¼ Watt, 5 % unless marked otherwise.

3. Capacitor values are in µF unless marked otherwise.

4.  This symbol indicates a circuit board ground.

5.  This symbol with a letter or number in it indicates a wire connected to the circuit board.

6.  This symbol indicates a plug-in connection.

* Keypad Switching Pattern

PRESSED KEY	PINS CONNECTED
OFF	9, 14
ON	9, 13
TUNE	1, 9
STOP	2, 6
P/C	6, 11
LOAD	6, 10
SEND	3, 6
WPM	2, 7
SPC'G	3, 7
WT	7, 11
RPT	7, 12
PRAC	6, 12
0	5, 8
1	8, 11
2	4, 8
3	2, 8
4	8, 12
5	8, 10
6	3, 8
7	7, 10
8	5, 7
9	4, 7

IC Vcc and Ground Pin Connections

IC	GND PIN #	+5 V PIN #	+5 A PIN #
U1	20, 21	40	
U2	8		22
U3	8		22
U4			
U5			
U6	7	14	
U7	8	1, 16	
U8	8	1	
U9	7	14	
U11	6, 7, 8	14	